

Département
D5: Complex Systems, Artificial Intelligence and Robotics

Équipe HUCEBOT

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Loria



Laboratoire lorrain de recherche en informatique et ses applications

Rapport d'activité 2025



En partenariat avec

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Project-Team HUCEBOT

Creation of the Project-Team: 2025 August 01

Keywords

Computer sciences and digital sciences

- A5.1. – Human-Computer Interaction
- A5.1.2. – Evaluation of interactive systems
- A5.1.3. – Haptic interfaces
- A5.1.5. – Body-based interfaces
- A5.1.9. – User and perceptual studies
- A5.10. – Robotics
- A5.10.1. – Design
- A5.10.2. – Perception
- A5.10.3. – Planning
- A5.10.4. – Robot control
- A5.10.5. – Robot interaction (with the environment, humans, other robots)
- A5.10.8. – Cognitive robotics and systems
- A5.11. – Smart spaces
- A5.11.1. – Human activity analysis and recognition
- A6. – Modeling, simulation and control
- A6.1. – Methods in mathematical modeling
- A6.4. – Automatic control
- A6.4.2. – Stochastic control
- A6.4.6. – Optimal control
- A9.2. – Machine learning
- A9.2.1. – Supervised learning
- A9.2.2. – Unsupervised learning
- A9.2.3. – Reinforcement learning
- A9.2.4. – Optimization and learning
- A9.2.5. – Bayesian methods
- A9.2.6. – Neural networks
- A9.2.8. – Deep learning
- A9.5. – Robotics and AI
- A9.7. – AI algorithmics
- A9.11. – Generative AI
- A9.14. – Evaluation of AI models
- A9.16. – Societal impact of AI

Other research topics and application domains

- B1.2.2. – Cognitive science
- B2.1. – Well being
- B2.2.7. – Virtual human twin
- B2.5. – Handicap and personal assistances
- B5. – Industry of the future
 - B5.1. – Factory of the future
 - B5.2.4. – Aerospace
 - B5.6. – Robotic systems
 - B5.8. – Learning and training
- B6.6. – Embedded systems
 - B9.6.1. – Psychology
 - B9.6.10. – Digital humanities
- B9.7.2. – Open data
- B9.9. – Ethics

1 Team members, visitors, external collaborators

Research Scientists

- Serena Ivaldi [Team leader, INRIA, Senior Researcher, from Aug 2025, HDR]
- Fabio Amadio [INRIA, Starting Research Position, from Nov 2025]
- Guillaume Bellegarda [INRIA, ISFP, from Oct 2025]
- Pauline Maurice [CNRS, Researcher, from Aug 2025]
- Enrico Mingo Hoffman [INRIA, ISFP, from Aug 2025]
- Jean-Baptiste Mouret [INRIA, Senior Researcher, from Aug 2025, HDR]

Faculty Member

- Maria Elisabetta Zibetti [UNIV PARIS VIII, Associate Professor Delegation, from Sep 2025]

Post-Doctoral Fellows

- Anna Bucchieri [UL, Post-Doctoral Fellow, from Aug 2025]
- Alexandre Oliveira Souza [INRIA, Post-Doctoral Fellow, from Nov 2025]
- Phani Teja Singamaneni [INRIA, Post-Doctoral Fellow, from Oct 2025]

PhD Students

- Mathis Antonetti [INRIA, from Aug 2025]
- Georgios Kalakonis [UL, from Dec 2025]
- Ioannis Loizou [INRIA, from Oct 2025]
- Raphael Lorenzo [INRIA, from Aug 2025]
- Thomas Martin [INRIA, from Aug 2025]
- Dionis Totsila [INRIA, from Aug 2025]
- Konstantinos Tsakonas [INRIA, from Aug 2025]
- Ioannis Tsikelis [INRIA, from Aug 2025]
- Aya Yaacoub [CNRS, from Aug 2025]

Technical Staff

- Fabio Amadio [INRIA, Engineer, from Aug 2025 until Oct 2025]
- Leonardo Bertelli [INRIA, Engineer, from Sep 2025]
- Raphael Bousigues [INRIA, Engineer, from Aug 2025 until Aug 2025]
- Clemente Donoso [INRIA, Engineer, from Aug 2025]
- Raphael Lartot [INRIA, Engineer, from Aug 2025 until Aug 2025]

Interns and Apprentices

- Célian Becques [CNRS, from Aug 2025 until Aug 2025]
- Mahmoud Elsayed [INRIA, Intern, from Aug 2025 until Aug 2025]
- Noemie Forest [INRIA, Intern, from Sep 2025]
- Louis Grohens [ENS Rennes, from Aug 2025 until Sep 2025]
- Sami Leroux [UL, from Oct 2025]
- Evangelos Tsiatsianas [UL, from Sep 2025]

Administrative Assistants

- Véronique Constant [INRIA]
- Antoinette Courrier [CNRS]
- Sylvie Hilbert [INRIA]
- Gallown Nizard [UL]

Visiting Scientists

- Meghan Huber [University of Massachusetts Amherst, from Nov 2025]
- Michael Vanuzzo [UNIV PADOVA, from Aug 2025 until Sep 2025]

2 Overall objectives

The HUCEBOT project-team was officially created on August 2025. It is dedicated to advancing algorithms for human-centered robots: robots that are not working autonomously in isolation, but that react, interact, collaborate, and assist humans to the best of their capacity. To do so, these robots need to intertwine multi-contact whole-body control, digital simulations of interacting humans, and data-driven models of human movements and intentions. The team's methods define a unified framework that enables the physical simulation and control of both virtual humans and robots, implemented into interconnected software libraries and modules that are validated on the many robotics platforms of LORIA (UMR 7503 CNRS/Université de Lorraine) and of the Inria Centre at Université de Lorraine. HUCEBOT's goal is to enhance workplace conditions for improved ergonomics and safety using robots: to either replace the human in dangerous and/or remote situations, using teleoperated robotic avatars; or to physically assist the human at work, using cobotics solutions such as exoskeletons.

Objectives

In HUCEBOT, we model humans with rigid body models, which makes them substantially equivalent to humanoid robots. When humans interact with robots (humanoids, cobots, exoskeletons, ...), the robot must control the contact forces between the two and the balance of the dyad (both must not fall) while satisfying the robot's and the human's dynamics constraints. Exoskeletons are wearable robots, i.e., articulated robots in physical contact with humans: simulating/controlling an exoskeleton requires modeling and controlling the physical contacts between the robot and the digital human/estimated human, which is therefore analogous to simulating/controlling a "more complex" humanoid robot. With this approach, all the modeling and control tools developed for humanoid robots can be extended to humans and wearable robots.

Our general goal is to improve the human well-being at work using human-centered robots: by replacing the human in dangerous and/or remote situations, using teleoperated robotic avatars that continuously interact with the operators and assist them in their remote operations; and by physically assisting the human at work, using collaborative robotics solutions such as exoskeletons to reduce their effort and minimize the risk of musculoskeletal disorders.

Our fundamental principle is that robots need to consider the human in their control, learning and adaptation processes: a human model and online estimator are needed, as they inform the controller about the human's current dynamics, intent and ergonomics. Our ambition is to develop user-specific modeling, control, prediction and learning algorithms that can be used by the robots to predict the human's intention and required assistance, and optimally control their movement and interaction to assist humans optimally.

To do so, the team relies on three scientific pillars: (1) whole-body control for human-robot collaboration; (2) digital human modeling and simulation; (3) data-driven human motion prediction.

3 Research program

Our research program builds on the ongoing research endeavors of the team members, who have experience in whole-body control, simulation and machine learning to different degrees. The program aims to address some of the current limits and constraints that prevent robots from physically assisting humans at work. Recognizing these limitations, we have identified several necessary advances in control, simulation, prediction and learning, as well as compelling practical applications to validate the new algorithms and methods. These include the development of robots designed to assist humans, physically and remotely, in tasks such as pushing carts, lifting heavy objects, and opening doors and drawers.

Incidentally, this kind of tasks are also addressed in the European project euROBIN, in which we lead the Work Package on Personal Robotics, and the field experiments of the PEPR O2R "Organic Robotics", where we coordinate the Focus Project on Decision, Learning and Interaction.

3.1 Axis 1 - Whole-body control for human-robot collaboration

Leaders: E. Mingo Hoffman, S. Ivaldi

Participants: J.-B. Mouret, P. Maurice, G. Bellegarda

Whole-body planning and control consist of techniques that exploit the entire body structure of a robot, e.g., multiple arms, limbs, and legs, its redundancy and its environment to execute a desired movement. Achieving complete whole-body control of a robotic system with real-time performances increases the capability of the platform to complete complex loco-manipulation tasks, also in terms of agility and dexterity. Whole-body controllers are implemented as optimal controllers leveraging mathematical programming techniques: typically, quadratic programming, which computes, for example, stabilizing Center of Mass trajectories, contact forces and the robot's joint commands (torques, positions), considering a model of the system, a cost to be minimized, and several constraints associated to the hardware and the environment. The main difficulty for whole-body controllers for robots is the real-time constraints: at every 1 *ms*, the robot needs to have a feasible solution to the optimization problem to control its motors.

Multi-contact and agile loco-manipulation

Our first objective is to design whole-body control schemes and algorithms that enable a humanoid robot (or an exoskeleton or a digital human model) to control its movement while interacting with the environment (including humans) engaging multiple contacts, manipulating heavy payloads, and executing agile and dynamic tasks. These are still big challenges, for both humanoid robots and exoskeletons, to overcome to have robots that physically help humans: they need to produce suitable forces and follow the humans in their movements, which are notably faster and more agile than what robots are capable of doing today. These new challenges add on top of the main control challenges associated with complex robotics systems, which are to balance and not fall, to not harm the human, and in general, to coordinate a large number of degrees-of-freedom. Our ambitious goal is to design and deploy whole-body control schemes on our robots to achieve the execution of agile loco-manipulation (e.g., climbing stairs, carrying payloads, pushing carts, throwing and catching) and teleoperated whole-body manipulation (e.g., manipulating objects in the environment at the natural human speed). Since we want robots to assist humans, they need to keep the pace that humans have in their activities, and not slow them down, to the point of frustration and human rejection. For example, an exoskeleton must follow the human's movements,

which are quite fast, without hindering their gestures; whereas a teleoperated robot avatar must execute the human's command in its remote environment as if the human would do them.

Leveraging machine learning for modeling, control and agile motions

We plan to investigate data-driven learning (see also Axis 3), both for generating candidate trajectories and to train new model-free controllers that go beyond the limits imposed by model-based controllers.

We will apply reinforcement learning over locomotion and loco-manipulation policies and leverage GPU accelerations, which have proven to be highly effective in quadrupedal locomotion but have not been fully explored in humanoid robotics [108].

Another problem that is yet unsolved for humanoid robots is how to rapidly change their contacts to improve their task manipulability, reducing energy consumption while maintaining their balance. Human demonstrations, reinforcement learning and quality diversity [145] are all promising techniques. The latter has been previously used in the team to generate one fast hand contact to preserve the balance of the robot in case of leg damage [31]: here, the challenge is to scale to many contacts and in particular to address rapid movements of the feet.

Human-aware collaborative controllers

We aim at designing **collaborative controllers that are “human-aware”**: at a low level, this means that the whole-body controller considers the human dynamics, possibly anticipating the human intents. In past work, we included the human model in the description of the system's dynamics in the formulation of our Quadratic Programming controller, considering that humans and robots were not two separate entities in interaction, but two parts of a single dynamics system to control [167, 151]. The collaboration/cooperation paradigm was fixed. We want to go beyond these limits: (1) reasoning in probabilistic terms about the possible ways humans will act and react to the robot's behavior, (2) adapting the robot's policy to the human behavior, (3) anticipating the human behavior and movement as well, using the methods of Axis 3.

3.2 Axis 2 - Digital human modeling and simulation

Leaders: P. Maurice, S. Ivaldi

Participants: E. Mingo Hoffman, J.-B. Mouret

Our second objective is to develop algorithms for the physical simulation of humans interacting with robots. Here the challenge is to be able to simulate their mutual interaction and in particular the effect that the robot has on the human body, considering individual factors and aligning as much as possible the simulation to the reality.

Experimental studies with human participants are at the core of our methodology.

Towards realistic simulation of humans and their tasks

Our ambition is to reduce the reality gap in the simulation, making sure the simulation is coherent with human physics and biomechanics so that it can be used for motion synthesis and analysis offline, and to inform the robot policies online. In the line of our past work, we seek a trade-off between the reality gap and the computational complexity: we will not develop musculo-skeletal models, but rigid body models, which are by definition an approximation of the real body but are faster to compute. In the same effort to reduce computational time, we will leverage Quadratic Programming approaches –possibly coupled with Model Predictive Control– to generate the motion of the human model. While the global optimality of the generated motion cannot be guaranteed, this coupling of a purely reactive low-level controller with higher-level planning drastically reduces computation costs compared to optimal control methods that are traditionally used to generate human motion. We aim to have: (1) a realistic physical simulation in terms of whole-body kinematics and dynamics features (e.g., shifts in the center of mass); (2) to obtain joint torques and efforts that are coherent with physiological measures, in particular in the case of interaction with wearable devices [150]; (3) have better models of fatigue (physical and cognitive) and its effect on human movements and constraints over time [172]. Having better models will enable

us to improve the quality of offline simulations and replay of data recorded at our partner’s premises, such as at the University Hospital of Nancy (CHRU Nancy) [95], at the Meurthe-et-Moselle Firefighters (SDIS54) Training Center [122].

Sensing and software

Adequate sensing is necessary to compare the simulated data with the ground truth. We usually work with **wearable sensors**: IMUs and motion capture suits (to track posture in real-time), EMG (to measure muscle activation and co-contraction), EKG (to measure cardiac activity, an indirect measure of physical effort), force plates (to measure contact forces and center of pressure during standing and locomotion) [128, 95]. Using all these sensors to capture human motion (both to record tasks and to have ground truth measurements) and their physiological status is possible in lab studies, but it is often infeasible in real-world experiments on the field and pilot studies. Wearable sensors will be used to collect data for training machine learning models of contact forces and “reality gap” correction terms that will be eventually integrated to the human simulation.

3.3 Axis 3 - Data-driven human movement prediction

Leaders: J.-B. Mouret, S. Ivaldi

Participants: E. Mingo Hoffman, P. Maurice, G. Bellegarda

The third objective is to develop machine learning algorithms to predict the future movement or intention so that the robot can anticipate the motion of the humans in time and thus better assist them. For example, we aim at leveraging supervised learning to find a function $f(\cdot)$ (e.g., a neural network) such that:

$$\hat{x}_{t+1}, \dots, \hat{x}_{t+N} = f(y_{t-K}, \dots, y_t)$$

where x_t is the state of a human at time-step t , \hat{x}_t is its prediction, N is the length of the prediction horizon and K is the length of the past observations y that are considered to make the prediction. In the simplest case, $y = x$ and so we only use the history of the human state to predict its future, but we can consider more cases in which y contains multimodal data, trajectories, sensor measurements, etc. While there exist numerous machine learning approaches for this kind of time-series prediction [111], we will contribute with novel dataset, models and learning algorithms that take advantage of the specific features of human trajectories in different environments and are well suited to the robotic context (typical dimensionality, uncertainty quantification, safety, ...). We focus on short predictions (typically 1-2 seconds) and on models that quantify their uncertainty and express different possible futures, so that they propose precise predictions when it is possible (e.g., continuing a well-known motion that already started) but keep the control/decision loop aware of their limitations.

Assistance will be translated into planning actions, sharing the autonomy on a task (e.g., blending assistive torques with the torques of the human), or visual suggestions to help an operator. Two challenges are particularly interesting: the first is anticipating to compensate for delays, either in the actuation or in the communication; the second is improving the prediction to consider unknowns (e.g., payloads) and contextual information (e.g., environment, task constraints).

Multimodal models

Our past algorithms for prediction of motion are limited because they only consider motion data. We want to incorporate in the prediction **contextual and multimodal information** that we can collect from other sensors or sources: 3-dimensional images of the situation, 360-cameras, operator’s eye tracker, sound, etc. We already showed that we can condition the motion primitives with additional information such as goals and obstacles [160]. A more general approach could consist of conditioning the prediction to multimodal data that represent the context or the environment (e.g., cameras, point clouds) and language instructions (e.g., in text form, using recent language models). A recent work by Google showed the potential of combining language description and action tokenization, and it is a very promising way to address contextual prediction [39]. In the past, we developed visual predictions of robot manipulation

with action labels [113] and multimodal predictions with visual images, speech and robot's end-effector trajectories [60], but the challenges now are precise predictions that can be used in real-time control, scaling to whole-body movements, and computationally "light" models.

Uncertainty and diversity

Interacting with humans in unstructured environments demands that our robots adapt creatively to unforeseen situations and new users, often falling outside the typical data distribution. While human operators play a pivotal role in adapting to these new situations, we are well aware that models and policies may overly specialize in specific scenarios or motions or make errors. To address this challenge, we propose two key strategies. First, we will integrate an **epistemic uncertainty** quantification approach into all our methods. This will involve exploring research avenues such as deep evidential regression [29] and traditional ensembles. We are especially attentive to advancements in epistemic uncertainty quantification for trajectory prediction, adapting our approach accordingly. In particular, a robot should not follow predictions that are deemed to be too uncertain, which would likely lead to a wrong behavior. Second, we will design algorithms to automatically design or curate diverse datasets. Over the past decade, we have largely contributed to **Quality Diversity** algorithms [49, 162], which are versatile optimization techniques that seek a diverse set of high-performing solutions to an optimization problem: in particular, Mouret & Clune proposed MAP-Elites [145], which is now one of the most common techniques in Quality Diversity and has originated several follow-up work (tracked in [this page](#)). In the coming years, we will harness and refine these algorithms to generate a variety of scenarios for the operators [64] and synthetic datasets amenable to optimal control solutions (see Axis 1). Part of this effort consists of developing suitable methods and tools to make Quality Diversity applicable to complex robotics control problems.

4 Application domains

The team members have been developing fruitful collaborations with several potential end-users of their technologies, for two main applications: physical assistance and teleoperation.

4.1 Physical assistance to improve ergonomics at work

We have been collaborating with several companies and institutes, mostly on the topic of estimating and improving ergonomics using human-centered technologies, wearable sensors and cobotics solutions. The most notable collaborations are with INRS and CEA, with two PhD theses co-supervised by P. Maurice, one co-supervised by S. Ivaldi and one by J.-B. Mouret. In the next years, our collaboration with CEA will be strengthened thanks to the PEPR O2R (Organic Robotics). Notably, we will apply the methods developed for human-aware and anticipatory control (see [Axis 1](#)), online ergonomics (see [Axis 2](#)) and motion prediction (see [Axis 3](#)) to their exoskeletons. We will also collaborate with the SHS team of CEA to investigate ethical issues and social acceptance of exoskeletons for physical assistance.

We have been developing several collaborations around the use of passive and active exoskeletons. A great collaboration about passive exoskeletons is with the University Hospital of Nancy (CHRU Nancy). In the project ExoTurn, passive exoskeletons were deployed in the Intensive Care Unit to alleviate the physical stress of physicians in prone positioning maneuvers. In the follow-up project ExoCare, we studied whether passive exoskeletons could be a viable tool to assist nurses during patients' bathing. In the current project ExoSim, we want to analyze more workstations and medical acts in the hospital, leveraging our software for digital simulations of the human workers (see [Axis 2](#)). Our agenda, supported by the CHRU staff, is to identify potential existing exoskeletons readily available to conduct pilot studies in situ (in the short term) and co-design new ad-hoc exoskeletons (in the long term).

We have been studying active exoskeletons to assist firefighters and first responders in their activities. On one side, we collaborated with the firefighters of Nancy (SDIS54), in the context of a LUE initiative led by P. Maurice. On the other side, we have been collaborating with Safran, in the context of a DGA Rapid project and then in the CIFRE thesis of A. Oliveira Souza, to develop controllers for active exoskeletons for first responders in logistic operations. We applied with SDIS54 and Safran to a Horizon Europe call with a project to design a new exoskeleton solution for their use case: since the proposal was rejected, we

will re-submit to other calls and in the meantime, we are funding this research & development activity internally. It is very important for our team because we want to develop our active exoskeleton solution and have full control of its software and low-level control. The methods developed in [Axis 1](#) will enable the design of controllers for manipulating heavy payloads, which we did not address in the past.

In the short term, we want to develop methods and devices for exoskeletons, to support the creation of X-hold (startup of the team, currently enrolled in Inria Startup Studio) and transfer our technologies, and at the same time to help our partners to deploy successfully exoskeletons in the field, providing recommendations and scientific assessment of available solutions. In the long term, we want to make modular exoskeletons that are light and affordable and can be ideal for our partners.

4.2 Remote teleoperation of robot avatars

We started in 2023 a collaboration with ESA, notably with the visiting research period of S. Ivaldi and J.-B. Mouret for 2 months at ESA/ESTEC in the HRI lab, hosted by T. Krueger and G. Visentin. We started the procedure for signing a MOU to formalize the collaboration. We are checking opportunities to join industrial consortia applying to ESA-funded space calls on specific robotics programs. In the long term, we aim to transfer part of our software developments to their team, to contribute to the software used in their missions, especially orbital maintenance and lunar exploration that involve significant teleoperation. E. Mingo Hoffman worked on an ESA-funded project during his previous employment, and he notably developed the controller of a European robot designed for orbital maintenance [135]. The teleoperation software will include whole-body controllers with the operator's anticipation and assistance (see [Axis 1-3](#)).

At the same time, we are interested in enabling humanoid robots to be used as avatars for real-life missions. This spans several applications, from construction to exploration and intervention (pioneering work in this area was done by IHMC [98]). We have been collaborating with PAL Robotics, the first European company commercializing humanoid robots, notably in the TIRREX project (Equipex Robotex2 via the CNRS) to define upgrades for our Talos robot, and the Horizon Europe project euROBIN where we received an upgrade of the Tiago robot. E. Mingo Hoffman was formerly employed as a researcher by PAL, where he implemented the control of their new humanoid Kangaroo. Our former engineer L. Renaud is now working in PAL. With the recent advent of several American, Chinese and European humanoid robots in the global market, we are now carefully tracking the developments of humanoid platforms. Our approach to survive in this research area is to develop robust and generic methods that adapt to different robots, aiming at non-specific algorithms and validating the methods on as many platforms as possible.

5 Social and environmental responsibility

5.1 Footprint of research activities

The team is engaged in reducing its carbon footprint by taking actions to reduce the number of travels. Project meetings are carried out in remote, when possible, and trains are the most preferable form of travel in Europe.

5.2 Impact of research results

Scientific Impact

Our research program has an impact on both the robotics and the human motion analysis communities. In robotics, our main focus is to address the pressing issues of agility and human-awareness by harnessing the power of machine learning and optimization-based control. Through our contributions, we aim to propel the scientific community toward realizing the vision of synergic whole-body human-robot connection, might it be for exoskeletons or humanoid robot. Our publication strategy mainly targets journals and conferences of the robotics domain, such as T-RO, RA-L, ICRA, IROS, Humanoids, HRI, etc. On the motion analysis side, we aim to develop algorithms that evaluate and optimize the ergonomics of specific motions, be it with or without interaction with robotic assistance (exoskeletons or cobots). This means collaborating with and contributing to the biomechanics and occupational ergonomics

communities. For instance, we plan to present our work at the annual congress of the Société de Biomécanique (France) and to submit to renowned biomechanics and ergonomics journals, such as Applied Ergonomics and Computer Methods in Biomechanics and Biomedical Engineering.

Economic Impact

Our plans for economic impact evolve in parallel with our research. Currently, our plans are:

- Transfer IP, knowledge and one patent (still in preparation for submission) about a semi-passive exoskeleton to the upcoming startup **X-hold**, led by our former engineers Raphael Bousigues and Raphael Lartot, currently enrolled in the Inria Startup Studio program. This plan is already in action.

In 2025, notably:

- Thanks to the project EXOCODESIM, we made significant progress in the design of one semi-passive exoskeleton and one active exoskeleton.
 - We started in June 2025 the process to submit a patent about the semi-passive exoskeleton, with the Inria STIP and Patent Office. We were not expecting such huge delays: as of now, the patent is not yet filed.
- Transfer IP, knowledge and one patent [27] to the startup **Bleu Robotics**, co-funded by Jean-Baptiste Mouret, Serena Ivaldi and Benoit Berkoukchi, currently incubated at Station F. This plan is already in action.

In 2025, notably:

- Thanks to the projects euROBIN and ATOR, we finalized our system and device for robot pointing. We started in May 2025 the process to submit the patent, with the Inria STIP and Patent Office. We wanted to submit the patent in September and later submit the journal paper using the system to a Special Issue of Science Robotics in October 2025. However, the patent process was longer than we estimated. Ultimately, the patent was submitted in November 2025 and we were able to submit later the journal paper for another T-RO special issue. The patent is still in the window of examination, so at this moment it is not yet accepted, and the paper is under review.
- Increase the TRL of our teleoperation solution, to make it robust, safe and usable by our partners in DGA (they funded our project ATOR), and possibly test it at their premises. This is a short/medium term plan.
 - Finalize our demonstrations for La Poste, in the context of the PhD thesis of Mathis Antonetti, focused on automatising the sorting and transport of boxes and bags with robots. This is a short term plan.
 - Consolidate our collaboration with ESA, to make them use our software for their robotics experiments and missions and to be involved in the latter. This is a long term plan.

Societal Impact

The common thread among our target domains is the overarching goal of enhancing the safety and ergonomic conditions of workers. This imperative resonates across various industries, particularly given the aging workforce and the trend toward extending retirement ages in many nations. Our research endeavors address this multifaceted challenge from two key angles:

- Ergonomics: We develop solutions that promote better ergonomics to safeguard the physical health of workers. Our efforts will also involve the advancement of exoskeletons, designed to alleviate muscle strain and reduce physical exertion on workers.

- **Remote Operation:** We aim to enhance safety by implementing remote operation capabilities, safeguarding workers from hazardous environments such as exposure to chemicals, asbestos, hostile situations, space exploration, and more.

It is noteworthy that the acceptance of these robotic technologies as tools and protective measures for workers often surpasses that of autonomous robots designed to replace human labor [62]. Additionally, these technologies are more readily integrated into existing workflows, as they empower human operators while giving them control over crucial decisions.

We stand by the idea that robotics solutions should be designed to help humans at work and assist them to improve their working conditions and their health. We are currently involved in these actions:

- **Firefighters:** the firefighters also handle more than 200,000 traffic accidents a year (2021), and we identified that they would benefit from the help of exoskeletons to extricate people from damaged vehicles, which involve moving and keeping in place heavy machinery in unusual positions, and to carry large weights, like stretchers with injured patients. We are actively collaborating with the SDIS 54 (firefighters in Meurthe et Moselle, our region) for evaluating existing exoskeletons and analyzing their gestures, and in the long term eventually developing ad-hoc exoskeletons.
- **Hospital:** we have a longstanding collaboration with the University Hospital of Nancy. In the past, we helped the physicians of the Intensive Care Unit by providing them exoskeletons to assist their gestures of prone positioning during the COVID pandemic. We followed up by evaluating if exoskeletons could assist nurses in bed bathing. We are currently involved in the ExoSim project to assess the benefit of exoskeletons in some particular gestures in the departments of laundry, logistic and restaurant. To accelerate the study, we are collecting data of different workstations to evaluate the potential of simulation tools to virtually test the exoskeleton's assistance and impact on the human body. The developed software, if validated by lab studies with human participants, has the potential to accelerate the evaluation, test and deployment of exoskeletons in all settings where field tests are difficult (the hospital is only one of those).

In 2025 notably:

- We made progress in the agreements between Inria, CNRS, UL and CHRU de Nancy, concerning the legal framework that allows our team to record data about the gestures of the workers at the Hospital Premises. Notably, we succeeded in having a meeting with the DPOs of Inria and CHRU de Nancy, who agreed on the terms for data collection, processing and sharing. Unfortunately, the contract is not yet finalized.
- We obtained approval from COERLE for the experiments at CHRU de Nancy.
- We conducted two field observation visits at the CHRU de Nancy, in laundry and restauration & logistics, to observe the work carried out on a daily basis, discuss with workers and evaluate the technical feasibility of the data collection.
- We prepared the Ethics protocols for lab evaluation studies for specific gestures that we identified as potential candidates for exoskeletons.

5.3 Ethics issues

We are well aware of ethics and technology acceptance issues related to the robotics applications we are studying. In the past, we led the Ethics Deliverable of the European Project AnDy, and we studied the principles of “ethically aligned design”, and we have considered technology acceptance models in the design of experimental material for our human-robot interaction experiments [120, 121, 123]. These methods are now regularly used in our research.

In the context of the PEPR O2R, we are intensifying collaborations with SHS experts, from psychology to anthropology. We are planning several experiments of human-robot interaction in lab and in the wild to study the acceptance of robots in different contexts of use, and investigate open questions in the design of controllers and behavior for human-robot interaction that account for ethics issues related to safety, anxiety, personalization, errors, and user empowerment.

In 2025, notably:

- Serena Ivaldi, Elisabetta Zibetti, Fabio Amadio co-authored a paper on Trust in HRI, stemming from a multidisciplinary work in PEPR O2R with anthropologists, psychologists, sociologists and roboticists [24].
- Serena Ivaldi participated to a training day about Ethics in AI & Robotics organized by GDR Robotique and PEPR.
- We submitted 7 ethics protocols for approbation to COERLE. Of those, 3 are not yet approved / they are still being processed.

5.4 Engagement for women in science

The team promotes equal opportunities for women and minorities. Female researchers of the team are frequently invited to present their research and career to girls and young women, and are engaged in the many activities organized by the institutes (Inria, CNRS) and the University of Lorraine. Some examples:

- Pauline Maurice participated in an event organized in Paris by CNRS Sciences Informatiques, to present the work of female researchers in digital science to high school students (several hundreds of students visited the event).
- Pauline Maurice and Serena Ivaldi participate to the GT Parité of GDR Robotique.
- Serena Ivaldi organized a communication campaign on LinkedIn to promote the female senior/junior researchers in the team through a series of interviews, during the Ada Lovelace Day.

6 Highlights of the year

- Creation of the team HUCEBOT
- Recrutement of Guillaume Bellegarda
- Creation of the startup Bleu Robotics by Serena Ivaldi and Jean-Baptiste Mouret.
- Serena Ivaldi was keynote speaker at the international conference IEEE Telepresence 2025.
- Presentation and robotics & AI demos for the Minister Clara Chappaz, in January 2025, in occasion of the inauguration of the Cluster AI project ENACT.

6.1 Awards

- **Julian Miller Award** by the SPECIES society for Jean-Baptiste Mouret. *The Julian Francis Miller Award is given for important contributions to the algorithmic exploration and embodiment of evolution, development and/or learning.*

7 Latest software developments, platforms, open data

New open-source projects on HUCEBOT's GitHub:

- OpenSOT, open library for whole-body control of robots under constraints – project led by Enrico Mingo Hoffman - [OpenSOT on HUCEBOT's GitHub page](#) and [its docker](#)
- g1pilot: teleoperation framework for the G1 robot - [GitHub page](#)
- AstroViz: ROS2 teleoperation GUI - [GitHub page](#)

7.1 Latest software developments

7.1.1 Exo_HMI

Keywords: GUI (Graphical User Interface), Man-machine interfaces

Functional Description: Web-based exoskeleton visualization and control software

Contact: Raphael Lartot

7.1.2 ShelfyInteractExtractor

Name: ShelfyInteractExtractor

Keywords: Omnidirectional video, Video analysis, Video annotation, 2D, 3D

Scientific Description: The scientific context of the project is the acquisition of a dataset in order to anticipate human-robot interaction.

The goal was to use a recording platform (a mobile or static robot) in a social environment (with people around) and to automatically detect whether these people are interacting (in this case: whether people are taking something from the robot's tray). Using this automatic a posteriori detection and input signals (sequence of images of a person, pose sequences (2D/3D skeleton), etc.), the goal is to anticipate before the interaction whether it will occur and when.

In order to extract and preprocess this data, a set of tools has been developed in ShelfyInteractExtractor. Some of the tools are dedicated to extraction from the raw formats recorded on the robot, some to automatic processing, some to manual correction of annotations, and finally, others to task execution for compliance with GDPR rules.

Functional Description: The features are implemented as Python scripts and can be executed sequentially, either manually or automatically:

Extraction: - Extraction of low-resolution images from rosbags, detection of people, and removal of "empty" passages directly in the rosbags - Extraction of high-resolution images, multichannel audio, LiDAR point clouds, and other synchronized data directly from rosbags - Extraction of 360 images from an omnidirectional camera from a video file (mkv) - Automatic temporal synchronization of 360 images using a flashing LED and a DTW algorithm

Processing: - People detection - Tracking and segmentation (SAM2) - Pose estimation (ViTPose and Sapiens) - Face detection and extraction of the best images for each tracked person - Embedding extraction for facial recognition - Automatic detection of physical interaction with the recording platform (robot)

Visualization: - Tool for viewing synchronized data (images, 360 images, LiDAR, etc.) - Tool for manual track correction - Tool for viewing extracted faces and filtering by similarity to a target face: applications for compliance with GDPR rules (requests for deletion by individuals)

Contact: Raphael Lorenzo

Partner: CEA-List

7.1.3 Interact360

Name: Interact360

Keywords: Omnidirectional camera, Visual tracking

Scientific Description: The goal is to address limitations in tracking and segmenting objects (in this case, people) using recent methods such as SAM2 in the context of equirectangular images.

To do this, the software tracks individuals one by one using a moving window.

The project originated from a desire to anticipate human-robot interaction. To this end, the software also contains scripts that enable feature extraction as a form of preprocessing (such as 2D pose estimation).

Functional Description: The software comprises several steps:

Extraction: extraction of images from videos. Detection/segmentation/tracking: using several steps, robust detection of people is performed and tracks are initialized with SAM2. A mobile tracking window allows them to be tracked even when they pass behind the camera (at the edge of the image).

Other processing: - 2D pose estimation with ViTPose/Sapiens - Automatic detection of people's interaction with a moving/fixed target (based on the intersection of segmentation masks)

Contact: Raphael Lorenzo

Partner: CEA-List

7.1.4 OpenSoT

Name: Open Stack of Tasks

Keywords: Robotics, Optimal control, Optimization, Motion control

Functional Description: OpenSoT is developed to simplify the creation and resolution of complex planning and control problems tailored to robotics. The library permits combining multiple tasks and constraints to set up a control problem in the form of a Quadratic Programming problem, which is then resolved by a solver using different strategies to handle priorities between tasks.

URL: <https://github.com/hucebot/OpenSoT?tab=readme-ov-file>

Contact: Enrico Mingo Hoffman

7.1.5 g1pilot

Name: ROS 2 package for Unitree G1 humanoid robots.

Keywords: Humanoid Robotics, Telerobotics

Functional Description: G1Pilot is an open-source ROS 2 package for Unitree G1 humanoid robots. Basically is made to leave the robot lower body to the controller of unitree while providing all necessary tools to control the upper body and teleoperate the robot. It exposes two complementary control Joint (low-level, per-joint) and Cartesian (end-effector) and continuously publishes core robot state for monitoring and visualization in RViz.

URL: <https://github.com/hucebot/g1pilot>

Contact: Jean-Baptiste Mouret

7.1.6 AstroViz

Name: Real-time data visualization suite for ROS 2 robotic missions

Keywords: Telerobotics, Robotics

Functional Description: AstroViz is the ultimate real-time data visualization suite for ROS 2 robotic missions. Built from the ground up for flexibility, clarity, and performance, AstroViz empowers roboticists, engineers, and field operators with a unified interface to monitor, control, and debug complex systems in real-time.

(1) All-in-one visualization: From GPS and LiDAR to camera feeds, robot state, and motor health, AstroViz integrates multiple views into a cohesive and modern GUI.

(2) High-performance: Docker-based deployment with GPU support ensures smooth operation even in data-intensive environments.

(3) Field-proven: Whether you're launching autonomous vehicles, drones, or ground robots, AstroViz is your visual command center.

Looking for a ROS 2 tool that goes beyond raw data and helps you make real-time decisions in the field? AstroViz is built for that.

URL: <https://github.com/hucebot/astroviz>

Contact: Jean-Baptiste Mouret

7.2 New platforms

- **Shelfy:** mobile robot for service robotics experiments and data collection in the wild. Design and building funded by PEPR O2R AS3.

Participants: Fabio Amadio, Raphael Lorenzo, Serena Ivaldi.

- **Exoskeletons:** prototypes for assistance of the upper-limbs: semi-passive and active. Design and building funded by EXOCODESIM, euROBIN, PEPR O2R PI3.

Participants: Raphael Bousigues, Raphael Lartot, Nicolas Beaufort, Alexandre Oliveira Souza, Pauline Maurice, Jean-Baptiste Mouret, Serena Ivaldi.

- Acquisition of commercial exoskeletons for the EXOSIM project: **HyperShell, MATE, HyQ, Omni-Suit.**

Participants: Anna Bucchieri, Pauline Maurice, Serena Ivaldi.

7.3 Open data

- HUI360: a dataset for predicting interactions of humans with a mobile service robot, in the wild (submitted to CVPR 2026) – data available on recherche.data.gouv.fr.

8 New results

8.1 Exoskeletons and ergonomics

Motion prediction for active exoskeleton control

Participants: Alexandre Oliveira Souza, Serena Ivaldi, Pauline Maurice.

This work is a joint PhD thesis with Safran (supervisors: Jordane Grenier and Christophe Guettier), and with Francois Charpillet from INRIA Nancy.

Occupational exoskeletons are a promising solution to physically assist people in strenuous tasks, such as load carrying. Compared to passive exoskeletons, active exoskeletons are more powerful and more versatile, so they can offer a better assistance for a wide variety of tasks. However, their interaction with the user remains a problem currently because there is usually a delay in the assistance, and the selection of the assistance remains often manual. Hence motion prediction could be a promising way to improve exoskeleton control by anticipating the required assistance.

In a previous work (published in 2024), we proposed a novel controller in which gravity compensation (standard in active upper-limb exoskeleton control) is complemented by a predictive impedance term. Thus an impedance control is added, in which the reference trajectory is the predicted human arm trajectory. We used an MLP (multi-layer-perceptron) as motion predictor, given that it requires only a limited amount of training data, which is crucial in the context of human-exoskeleton interaction. In 2024, we evaluated this novel controller with respect to transparency (i.e., when no load is manipulated). This year, we extended the study to the actual use case of load manipulation in a repetitive task. This first required designing a new upper-limb bi-manual exoskeleton prototype on which we implemented our controller (the one used in the previous experiment was not dimensioned for load manipulation). We then conducted an experiment in which human participants performed a repetitive load manipulation task without the exoskeleton, with the exoskeleton using a baseline gravity compensation controller, and with the exoskeleton using our predictive controller. The experiment showed that the predictive controller enables to slightly reduce some side effect induced by the baseline gravity compensation controller, owing to the anticipation of the required assistance. While small, this effect was perceived by the participants who consistently preferred the predictive controller than the baseline one.

This work was presented in the PhD thesis of Alexandre Oliveira Souza, defended in September 2025. A journal paper is also in preparation.

Human-exoskeleton simulation

Participants: Alexandre Oliveira Souza, Anna Bucchieri, Francois Charpillat, Serena Ivaldi, Pauline Maurice.

This work is partly funded by a joint PhD thesis with Safran (supervisors: Jordane Grenier and Christophe Guettier), and by the LUE ExoSim project (PI: Serena Ivaldi).

Building on the team expertise and tools on physics-based digital human simulation, we have been developing a simulation tool that enables to simulate human-exoskeleton interaction. Both the human and the exoskeletons are modeled as polyarticulated kinematic chains (including dynamics properties), and controlled to generate desired motions. The digital human is animated using a quadratic programming control, standard in humanoid robotics. The exoskeleton is controlled using any controller that we want to test. Using physics-based simulation allows to simulate the interaction force between both agents, and hence to generate motions that account for this interaction force. Such simulation has a strong potential to help design and assess exoskeletons (mechanical design and control), since it enables to evaluate biomechanical effects on the human without the need for time-consuming human experiment. It can be used to select suitable exoskeleton for a given task (before an actual validation with real experiment), or in an optimization-based design process (e.g., co-design).

One challenge in such simulation is to model the human-exoskeleton physical interaction. We proposed to use a visco-elastic (spring damper) contact model at the attachment points. This is a suitable compromise between the reality of the non-rigid contact, and the complexity and computational cost of models such as finite elements. We proposed to identify suitable parameters of the model using Bayesian optimization to match experimental data. We showed that this simulation can be used to estimate the assistance of an upper-limb exoskeleton on human physical effort (joint torque.)

This work was presented in the PhD thesis of Alexandre Oliveira Souza, and presented in two international conferences [23, 17]

Physics-based simulation for human motion analysis

Participants: Anna Bucchieri, Serena Ivaldi, Pauline Maurice.

This work is funded by the LUE ExoSim project (PI: Serena Ivaldi).

In this work, we used the same basis for physics-based simulation of human motion as in the previous section. The goal is to develop a tool to quantitatively analyze human physical ergonomics (motion and internal effort) of occupational activities, recorded with motion capture. Most existing approaches rely on inverse kinematics and inverse dynamics analysis, from motion capture data. Here, we proposed to use an integrated approach that directly computes the internal forces from the motion capture data, using quadratic programming control. This technique has the advantage that the recorded motion can then be used as a reference, but effects of physical assistance, such as exoskeletons, can be taken into account (i.e., the motion can be modified by the assistance).

This year, we validated the accuracy of the estimated motion and internal forces of our approach against the standard inverse kinematics - inverse dynamics approach. We used an existing dataset (within the team) to compare the performance of both approaches. We showed that while the accuracy of our approach was slightly worse than the gold standard, it was still suitable for ergonomics analysis. However our approach is currently limited to motion with fixed feet. We are currently working towards extending it to motion with feet displacements.

This work was published (and presented) as an international conference paper [13], and also presented in a national biomechanics conference [21].

Analysis of human motion variability in an manual task

Participants: Célian Becques, Pauline Maurice.

This work is a collaboration with INRS (National Institute for Occupational Health), in particular with Jonathan Savin

Human motion is intrinsically variable, owing to multiple inter- and intra-individual factors (e.g., morphology, expertise, fatigue...). At the kinematic level, this leads to adopting different postures when performing a gesture. While this is known, this phenomenon is largely ignored in workstations assessment and design. Workstation design is often done using software tools that allow to simulate a human at work, to evaluate biomechanical risks (in particular risk of developing work-related musculoskeletal disorders (WMSD)). But these tools enable to simulate one single way of performing a task, ignoring variability. Actually, there exists very little quantitative knowledge about motion variability in occupational tasks, let alone models to predict and simulate it in a realistic way. This work is part of a research line aiming at modeling and characterizing human motor variability in occupational tasks, and providing tools to account for it in workstation design. This is especially important with the increase of robotic-assisted workstations, where extra care should be taken such that the robot does not reduce natural human motion variability, which would be detrimental to WMSD risk reduction.

The work conducted this year is a first step in this project. We analysed data from a human subject experiment conducted in a previous year. In this experiment, participants had to perform a manual trajectory tracking task repeatedly, and in different pace conditions. This year, we performed kinematic analysis of the collected data, to evaluate the variability in upper-limb posture, and its impact on WMSDs risk. We showed that motor variability is indeed present, and started investigating the factors affecting it. Importantly, we showed that standard ergonomics assessment scores are significantly affected by this variability. This means that conducting a risk analysis on one trial (one way of performing the task) only, while ignoring variability, may lead to an under-estimation of the risk.

This work has been accepted for a presentation in a conference taking place in 2026, and a journal paper is currently in preparation.

Adaptive control of collaborative robots for preventing musculoskeletal disorders

Participants: Aya Yaacoub, Pauline Maurice.

This work is part of Pauline Maurice's ANR JCJC ROOIBOS project. It has been conducted in collaboration with Francis Colas and Vincent Thomas from the Larsen team.

The use of collaborative robots in direct physical collaboration with humans constitutes a possible answer to musculoskeletal disorders: not only can they relieve the worker from heavy loads, but they could also guide them towards more ergonomic postures. In this context, one objective of the ROOIBOS Project is to build adaptive robot strategies that are optimal regarding productivity but also the long-term health and comfort of the human worker, by adapting the robot behavior to the human's physiological state.

To do so, in a previous work (published in 2023), we proposed to use Partially Observable Markov Decision Processes (POMDP) to compute a robot policy taking into account the long-term consequences of the biomechanical demands on the human worker's joints (joint loading) and to distribute the efforts among the different joints during the execution of a repetitive task. This approach also allows to take into account the uncertainty of the human postural reaction to a robot action (i.e., the whole-body posture of the human, and hence the internal efforts, cannot be predicted with certainty just knowing the robot motion).

This year, we have been designing an experiment to validate the effectiveness of the proposed POMDP-based planning approach for fatigue mitigation with human subjects, in a human-robot comanipulation task. Due to various human difficulties, we were not able to complete the experiment this year. However, we have prepared the protocol, and part of the set-up. The actual experiment is planned to be carried out in 2026.

This work (the approach, without the results) is presented in the PhD thesis of Aya Yaacoub, who will be defending in early 2026.

Influence of non-biological motion pattern on human-robot physical collaboration

Participants: Pauline Maurice.

This work is in collaboration with the Action Lab of Northeastern University, USA (PI: Dagmar Sternad, PhD student: Mahdi Edraki, PostDoc: H  l  ne Serr  ).

In a previous work we showed that when physically collaborating with a robot, the interaction is easier for the human when the robot moves according to a human-like motion pattern (compared to a non-human-like pattern). However the motion profile of a robot can be constrained by the task or the environment and then cannot necessarily follow a human-like pattern. In this work, we conducted an experimental user-study to assess if and how humans can improve their performance when collaborating with a robot that moves according to a non-human-like pattern. 41 subjects practiced a collaborative task with a robot over 3 days, with and without augmented feedback, with various motion profiles. We showed that humans can improve even with a non-biological profile, but only when augmented feedback is provided. Then, we analyzed possible features of motion that could explain the difficulty of following a non-biological movement pattern. We showed that the difference between biological and non-biological angular velocity is a good predictor of the difficulty of following the trajectory.

This work was presented in a journal paper that has been accepted and will be published early 2026.

8.2 Robots in remote and hazardous environments

Flying in air ducts

Participants: Jean-Baptiste Mouret, Thomas Martin.

Air ducts are integral to modern buildings but are challenging to access for inspection. Small quadrotor drones (teleoperated or autonomous) offer a potential solution, as they can navigate both horizontal and vertical sections and smoothly fly over debris. However, hovering inside air ducts is problematic due to the airflow generated by the rotors, which recirculates inside the duct and destabilizes the drone.

In this work, we mapped the aerodynamic forces that affect a hovering drone in a duct using a robotic setup and a force/torque sensor. Based on the collected aerodynamic data, we identified a recommended position for stable flight, which is not the center of a circular duct. We then developed a neural network-based positioning system that leverages low-cost time-of-flight sensors.

By combining these aerodynamic insights and the data-driven positioning system, we showed how to improve the stability of a small quadrotor drone (here, 180 mm) inside small air ducts (down to 350 mm diameter) and fly autonomously over 2 m.

This work was advertised with a press release and covered by a few French media (e.g., [France 3 Lorraine / Soir 3](#), [Les Échos](#), [Science&Avenir](#), [Planete Robots](#), [L'Usine Nouvelle](#), ...).

Publication: [9] (npj Robotics) - [\[video\]](#)

8.3 Robot learning, AI & control

Safe Bimanual Teleoperation with Language-Guided Collision Avoidance

Participants: Dionis Totsila, Serena Ivaldi, Jean-Baptiste Mouret, Clemente Donoso, Enrico Mingo Hoffman.

Teleoperating precise bimanual manipulations in cluttered environments is challenging for operators, who often struggle with limited spatial perception and difficulty estimating distances between target objects, the robot's body, obstacles, and the surrounding environment. To address these challenges, local robot perception and control should assist the operator during teleoperation.

We introduced a safe teleoperation system that enhances operator control by preventing collisions in cluttered environments through the combination of immersive VR control and voice-activated collision avoidance. Using HTC Vive controllers, operators directly control a bimanual mobile manipulator, while spoken commands such as "avoid the yellow tool" trigger visual grounding and segmentation to build 3D obstacle meshes. These meshes are integrated into a whole-body controller to actively prevent collisions during teleoperation.

Experiments in static, cluttered scenes demonstrated that our system significantly improves operational safety without compromising task efficiency. Publication: [18] (IEEE Telepresence conference 2025)

Extremum Flow Matching for Offline Goal Conditioned Reinforcement Learning

Participants: Quentin Rouxel, Serena Ivaldi, Jean-Baptiste Mouret, Clemente Donoso.

Imitation learning is a promising approach for enabling generalist capabilities in humanoid robots (for prediction of motion, for autonomous policies or for shared control), but its scaling is fundamentally constrained by the scarcity of high-quality expert demonstrations. This limitation can be mitigated by leveraging suboptimal, open-ended play data, often easier to collect and offering greater diversity.

We build upon recent advances in generative modeling, specifically Flow Matching, an alternative to Diffusion models. We introduce a method for estimating the minimum or maximum of the learned distribution by leveraging the unique properties of Flow Matching, namely, deterministic transport and support for arbitrary source distributions. We apply this method to develop several goal-conditioned imitation and reinforcement learning algorithms based on Flow Matching, where policies are conditioned on both current and goal observations. We explore and compare different architectural configurations by combining core components, such as critic, planner, actor, or world model, in various ways. We evaluated our agents on the OGBench benchmark and analyzed how different demonstration behaviors during data collection affect performance in a 2D non-prehensile pushing task.

Furthermore, we validated our approach on real hardware by deploying it on the Talos humanoid robot to perform complex manipulation tasks based on high-dimensional image observations, featuring a sequence of pick-and-place and articulated object manipulation in a realistic kitchen environment. Experimental videos and code are available at: www — Publication [15] (IEEE Humanoids conference 2025) – Selected Oral presentation.

AHMP: Agile Humanoid Motion Planning with Contact Sequence Discovery

Participants: Ioannis Tsikelis, Evangelos Tsiatsianas, Serena Ivaldi, Enrico Mingo Hoffman.

Planning agile whole-body motions for legged and humanoid robots is a fundamental requirement for enabling dynamic tasks such as running, jumping, and fast reactive maneuvers. In this work, we present AHMP, a multi-contact motion planning framework based on bi-level optimization that integrates a contact sequence discovery technique, using the Mixed-Distribution Cross-Entropy Method (CEM-MD), and an efficient trajectory optimization scheme, which parameterizes the robot's poses and motions in the tangent space of SE(3). AHMP permits the automatic generation of feasible contact configurations, with associated whole-body dynamic transitions. We validate our approach on a set of challenging agile motion planning tasks for humanoid robots, demonstrating that contact sequence discovery combined with tangent space parameterization leads to highly dynamic motion plans while remaining computationally efficient. – Publication [19] (IEEE Humanoids conference 2025) – Selected Oral presentation.

Learning to Walk with Hybrid Serial-Parallel Linkages: a Case Study on the Kangaroo Robot

Participants: Fabio Amadio, Serena Ivaldi, Enrico Mingo Hoffman.

Humanoid robots increasingly adopt hybrid serial-parallel kinematics to improve structural stiffness, mass distribution, and impact robustness. However, these mechanisms introduce complexity associated with simulation and control, which impacts algorithms for Reinforcement Learning (RL) based locomotion. We studied the case of an RL end-to-end pipeline that trains walking policies for Kangaroo, a 72 degrees of freedom biped whose legs contain several hybrid serial-parallel chains, without kinematic simplifications. Training is performed using the Isaac Lab framework, leveraging the Isaac Sim built-in constraint capabilities. An ablation study on the observation state is carried out to find evidence in the use of redundant information from the measured state of the robot, i.e., using the passive and/or active joint measurements available in Kangaroo. A set of trained policies is validated in MuJoCo, demonstrating a degree of robustness to the Simto-Sim gap, provided that the equality-constraint stiffness and other simulation parameters are properly tuned. The closed-loop behaviors of the tested policies successfully transfer in most cases, despite differences in how contacts and constraints are modeled across the two simulators. Furthermore, we analyzed how minor differences in the action rate penalty weight used during training can deeply affect the locomotion stability of the resulting policies when deployed in a different simulation environment. – Publication [20] (SII 2025)

Vision-language models for joint attention in human-robot interaction

Participants: Dionis Totsila, Jean-Baptiste Mouret, Clemente Donoso, Serena Ivaldi.

Humanoid robots need joint attention mechanisms to collaborate efficiently with humans, for example, to precisely identify points of common interest that are critical for manipulation tasks, balancing, or the execution of a desired task. To this end, the robot needs to understand human instructions about tasks, objects, and locations; predict 3D points of interest in the shared environment; and clearly communicate its prediction to the human, engaging in a dialogue to iteratively refine its prediction until the human

is satisfied and the robot can proceed with its task. In this work, we leverage foundation models in a modular framework that enables the identification and iterative refinement of 3D points of interest from human instructions. Our architecture, named LaserAttention, lifts the semantic reasoning of off-the-shelf 2D Vision-Language Models (VLMs) into precise 3D contact frames by integrating geometric segmentation, achieving a median spatial error of 3.09 cm, significantly outperforming end-to-end baselines. We introduce a physically grounded legibility interface: a custom 2-DoF laser that projects the robot's intended contact point into the shared workspace. This mechanism externalizes the robot's internal reasoning before action, enabling a dialogue where users can visually verify and iteratively refine spatial goals. Extensive experiments on two different humanoid platforms (TALOS and TIAGo++) and a user study demonstrate that this approach allows for zero-shot generalization while significantly reducing cognitive workload and enhancing trust compared to standard arm-pointing gestures. – A paper about this work is currently submitted to a journal.

8.4 Human-robot interaction

What Can Robots Teach Us About Trust and Reliance? An interdisciplinary dialogue between Social Sciences and Social Robotics

Participants: Serena Ivaldi, Maria Elisabetta Zibetti, Fabio Amadio.

This is a paper written by several members of the PEPR O2R AS3 project, as part of our efforts to increase the multi-disciplinarity of our research and strengthen the collaboration between robotics and SHS. As robots find their way into more and more aspects of everyday life, questions around trust are becoming increasingly important. What does it mean to trust a robot? And how should we think about trust in relationships that involve both humans and non-human agents? While the field of Human-Robot Interaction (HRI) has made trust a central topic, the concept is often approached in fragmented ways. At the same time, established work in sociology, where trust has long been a key theme, is rarely brought into conversation with developments in robotics. This article argues that we need a more interdisciplinary approach. By drawing on insights from both social sciences and social robotics, we explore how trust is shaped, tested and made visible. Our goal is to open up a dialogue between disciplines and help build a more grounded and adaptable framework for understanding trust in the evolving world of human-robot interaction. – Publication [24] (8th International Workshop on Human-Friendly Robotics 2025, HFR 2025).

A 360° Egocentric Dataset and Baselines for Human-Robot Interaction Anticipation

Participants: Raphael Lorenzo, Serena Ivaldi, Fabio Amadio.

This work is done in the context of the PEPR O2R AS3 project, in particular in the collaboration with CEA, where we want to develop methods for anticipating when humans want to interact with the robot. To this end, we collected the largest dataset for human-robot interaction anticipation in the wild (1M pre-processed annotations, including detailed 2D poses, facial keypoints, and segmentation masks) and we introduced it with its set of baselines. The dataset was collected from our mobile robot Shelfy, in the wild, over multiple days within a 3-month period, and in several environments, capturing natural, spontaneous behaviors from both passersby and users, and encompassing a diverse range of individuals. This variety enables evaluating and improving the generalization capabilities of interaction anticipation models. – This work is currently submitted as a conference paper.

Real-Time Spatially Aware Human Motion Prediction: The PADEON Approach

Participants: Serena Ivaldi, Fabio Amadio, Michael Vanuzzo.

This work is done in the context of the visiting period of Michael Vanuzzo, where he developed a novel deep learning framework that incorporates spatial semantics into HMP using a graph-based architecture. We contributed with experimental design of two human-robot collaborative scenarios inspired by assembly tasks where the prediction is used. – This work is currently submitted as a conference paper.

9 Bilateral contracts and grants with industry

9.1 Bilateral contracts with industry

PhD grant (CIFRE) with SAFRAN

Participants: Alexandre Oliveira Souza, Pauline Maurice, Serena Ivaldi, Francois Charpillat.

Collaboration with Jordane Grenier (Safran) and Christophe Guettier (Safran).

The thesis is funded by Safran to develop the AI-based control of their hybrid exoskeleton, based on the one developed in the DGA-Rapid project ASMOA. It consists in developing methods to predict the amount of assistance that is needed by the human in tasks involving payload manipulation.

PhD with CEA

Participants: Raphael Lorenzo, Serena Ivaldi.

This contract concerns exclusively the IP related to the PhD of Raphael Lorenzo, co-supervised by Serena Ivaldi and Bertrand Luvison in CEA. The PhD is funded by PEPR O2R AS3; it started on October 2024. *The contract is not yet signed.*

PhD with CEA

Participants: Quentin Rolland, Jean-Baptiste Mouret.

This contract concerns the compensation plus IP related to the PhD of Quentin Rolland, co-supervised by Jean-Baptiste Mouret and Fabrice Mayran de Chamisso in CEA. The PhD is funded by CEA; it started on November 2024. *The contract is not yet signed.*

Convention d'accueil with CHRU Nancy

Participants: Serena Ivaldi, Pauline Maurice, Anna Bucchieri.

This contract concerns the agreement between CHRU, UL and Inria, to authorise our team members to enter the CHRU premises to conduct experiments in the context of the ExoSim project (scientific project funded by LJE). The project started on July 2024. *The contract is not yet signed.*

9.2 Bilateral grants with industry

None.

10 Partnerships and cooperations

10.1 International initiatives

10.1.1 Associate Teams in the framework of an Inria International Lab or in the framework of an Inria International Program

Title: LEG-AI – Learning and Generative AI methods for Control of Legged Robots

Partner Institution(s): University College London (UCL), London, UK

Date/Duration: 2025–2028

Additional info/keywords: legged locomotion, AI, control

Description: Building on a longstanding track record of previous joint publications and projects, the strategic collaboration LEG-AI between the Inria HUCEBOT team and the robotics & AI researchers of the Department of Computer Science of the University College London (UCL) seeks to push the boundaries of legged locomotion and develop adaptive, autonomous control strategies for both quadruped and humanoid robots in challenging environments. Established in 2025, this collaboration which is driven by the use of state-of-the-art methods in deep learning, generative AI, vision transformers, and evolutionary algorithms, promotes knowledge sharing, methodologically and experimentally, and fosters collaboration. Such results are reached through a structured program of research visits between the centre Inria de l'Université de Lorraine and UCL which enhance the condition to share the teams's specialized expertise and strengthen experimental evaluation by sharing complementary robotics platforms.

10.2 International research visitors

10.2.1 Visits of international scientists

Inria Visiting Researcher

Meghan Huber

Status : Assistant Professor

Institution of origin: University of Massachusetts Amherst

Country: USA

Dates: July and December 2025 (2 months)

Context of the visit: Initiating a long-term research collaboration with Pauline Maurice, on exoskeletons and human movement in physical human-robot interaction.

Mobility program/type of mobility: Research stay (funded by Inria "Visiting Researcher" fellowship)

Other international visits to the team

Michael Vanuzzo

Status PhD

Institution of origin: University of Padova

Country: Italy

Dates: March–August 2025

Context of the visit: Collaboration on prediction algorithms for human-robot collaboration.

Mobility program/type of mobility: Erasmus program to have a visiting period abroad during the PhD, funded by the University of Padova.

Luca Rossini**Status** post-Doc**Institution of origin:** Istituto Italiano di Tecnologia**Country:** Italy**Dates:** January 2025 (2 weeks)**Context of the visit:** Continue research collaboration on optimal control for legged systems under the euROBIN and MeRLin projects.**Mobility program/type of mobility:** Research stay and lecture funded by euROBIN EU Project**Francesco Ruscelli****Status** post-Doc**Institution of origin:** Istituto Italiano di Tecnologia**Country:** Italy**Dates:** January 2025 (2 weeks)**Context of the visit:** Continue research collaboration on optimal control for legged systems under the euROBIN and MeRLin projects.**Mobility program/type of mobility:** Research stay and lecture funded by euROBIN EU Project**Evangelos Tsiatsianas****Status** Intern (Master)**Institution of origin:** University of Patras**Country:** Greece**Dates:** September 2025 to February 2026 (6 months)**Context of the visit:** Master thesis on optimal control on manifold for legged systems under the MeRLin project.**Mobility program/type of mobility:** Internship (funded by ORION Program)**10.2.2 Visits to international teams****Enrico Mingo Hoffman****Visited institution:** Dipartimento di Ingegneria Informatica, Automatica e Gestionale at the Sapienza University of Rome**Country:** Italy**Dates:** March and November 2025 (2 weeks and 1 week)**Context of the visit:** Continue the collaboration with the Robotics department on themes concerning optimal control for legged systems. Invited lecture on “Modeling and Control of Hybrid Serial–Parallel Floating-Base Systems.”**Mobility program/type of mobility:** Research stay and lecture, partially funded by the MeRLin project.

Serena Ivaldi, Dionis Totsila, Raphael Lorenzo, Ioannis Tsikelis and Fabio Amadio**Visited institution:** Department of Robotics at University College London**Country:** UK**Dates:** December 2025 (1 week)**Context of the visit:** collaboration with Prof. Valerio Modugno in the context of the joint team LEG-AI (Inria equipe associée).**Mobility program/type of mobility:** Research stay and planned experiments, funded by LEG-AI.**Research stays abroad****Serena Ivaldi and Jean-Baptiste Mouret****Visited institution:** Stanford University**Country:** California, USA**Dates:** 10–21 August 2025**Context of the visit:** PEPR O2R is funding international mobilities to develop collaborations with prestigious Universities and Institutes.**Mobility program/type of mobility:** (sabbatical, internship, research stay, lecture...) Research stay, with two lectures at the Stanford Seminar and several visits of different labs in Computer Science, Aerospace Engineering, Biomechanics.**Guillaume Bellegarda****Visited institution:** Lund University**Country:** Sweden**Dates:** 03–21 November 2025**Context of the visit:** Invited visiting scholar for the ELLIIT 2025 Robot Learning Focus Period .**Mobility program/type of mobility:** (sabbatical, internship, research stay, lecture...) Research stay, with two invited talks: one research seminar and one course lecture.**10.3 European initiatives****10.3.1 Horizon Europe****euROBIN****Participants:** Serena Ivaldi, Jean-Baptiste Mouret, Enrico Mingo Hoffman, Guillaume Bellegarda, Dionis Totsila, Phani Teja Singamaneni, Leonardo Bertelli, Alexandre Oliveira Souza.**Title:** European ROBotics and AI Network of Excellence**Duration:** July 2022 – December 2026**Partners:**

- INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET AUTOMATIQUE (INRIA), France

- C.R.E.A.T.E. CONSORZIO DI RICERCA PER L'ENERGIA L AUTOMAZIONE E LE TECNOLOGIE DELL'ELETTROMAGNETISMO (C.R.E.A.T.E.), Italy
- PAL ROBOTICS SLU (PAL ROBOTICS), Spain
- KUNGLIGA TEKNISKA HOEGSKOLAN (KTH), Sweden
- INSTITUT JOZEF STEFAN (JSI), Slovenia
- FRAUNHOFER GESELLSCHAFT ZUR FORDERUNG DER ANGEWANDTEN FORSCHUNG EV (Fraunhofer), Germany
- FUNDACION TECNALIA RESEARCH & INNOVATION (TECNALIA), Spain
- TECHNISCHE UNIVERSITAET MUENCHEN (TUM), Germany
- DHL EXPRESS SPAIN SL, Spain
- COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES (CEA), France
- INTERUNIVERSITAIR MICRO-ELECTRONICA CENTRUM (IMEC), Belgium
- TEKNOLOGISK INSTITUT (DANISH TECHNOLOGICAL INSTITUTE), Denmark
- UNIVERSITEIT TWENTE (UNIVERSITEIT TWENTE), Netherlands
- ASEA BROWN BOVERI SA (ABB), Spain
- ECOLE POLYTECHNIQUE FEDERALE DE LAUSANNE (EPFL), Switzerland
- MATADOR INDUSTRIES AS, Slovakia
- DEUTSCHES ZENTRUM FUR LUFT - UND RAUMFAHRT EV (DLR), Germany
- IST-ID ASSOCIACAO DO INSTITUTO SUPERIOR TECNICO PARA A INVESTIGACAO E O DESENVOLVIMENTO (IST ID), Portugal
- UNIVERSITA DI PISA (UNIFI), Italy
- FUNDINGBOX ACCELERATOR SP ZOO (FBA), Poland
- UNIVERSITAET BREMEN (UBREMEN), Germany
- FONDAZIONE ISTITUTO ITALIANO DI TECNOLOGIA (IIT), Italy
- KARLSRUHER INSTITUT FUER TECHNOLOGIE (KIT), Germany
- EIDGENOESSISCHE TECHNISCHE HOCHSCHULE ZUERICH (ETH Zürich), Switzerland
- CESKE VYSOKE UCENI TECHNICKE V PRAZE (CVUT), Czechia
- OREBRO UNIVERSITY (ORU), Sweden
- CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS (CNRS), France
- VOLKSWAGEN AKTIENGESELLSCHAFT (VW AG), Germany
- SIEMENS AKTIENGESELLSCHAFT, Germany
- SORBONNE UNIVERSITE, France
- UNIVERSIDAD DE SEVILLA, Spain

Inria contact: Serena Ivaldi

Coordinator: Prof. Dr. Alin Albu-Schäffer (DLR)

Summary: As robots are entering unstructured environments with a large variety of tasks, they will need to quickly acquire new abilities to solve them. Humans do so very effectively through a variety of methods of knowledge transfer – demonstration, verbal explanation, writing, the Internet. In robotics, enabling the transfer of skills and software between robots, tasks, research groups, and application domains will be a game changer for scaling up the robot abilities.

euROBIN therefore proposes a threefold strategy: First, leading experts from the European robotics and AI research community will tackle the questions of transferability in four main scientific areas: 1) boosting physical interaction capabilities, to increase safety and reliability, as well as energy efficiency 2) using machine learning to acquire new behaviors and knowledge about the environment

and the robot and to adapt to novel situations 3) enabling robots to represent, exchange, query, and reason about abstract knowledge 4) ensuring a human-centric design paradigm, that takes the needs and expectations of humans into account, making AI-enabled robots accessible, usable and trustworthy.

Second, the relevance of the scientific outcomes will be demonstrated in three application domains that promise to have substantial impact on industry, innovation, and civil society in Europe. 1) robotic manufacturing for a circular economy 2) personal robots for enhanced quality of life 3) outdoor robots for sustainable communities. Advances are made measurable by collaborative competitions.

Finally, euROBIN will create a sustainable network of excellence to foster exchange and inclusion. Software, data and knowledge will be exchanged over the EuroCore repository, designed to become a central platform for robotics in Europe.

The vision of euROBIN is a European ecosystem of robots that share their data and knowledge and exploit their diversity to jointly learn to perform the endless variety of tasks in human environments.

10.4 National initiatives

10.4.1 PEPR O2R: AS3

Participants: Serena Ivaldi, Jean-Baptiste Mouret, Enrico Mingo Hoffman, Pauline Maurice, Guillaume Bellegarda.

Program: PEPR

Project acronym: AS3

Project title: Decision, Apprentissage et Interaction Sociale

Duration: January 2024 – December 2031

Coordinator: Serena Ivaldi

Local coordinator: Serena Ivaldi

Abstract: The major scientific challenge of this structuring action is to lay the foundations for new society-centered decision-making, learning, and interaction algorithms. We have identified four key challenges that will lie at the heart of the scientific development of this project: human anticipation and prediction, multimodal interaction, learning during interactions, and trust. Our approach to addressing these challenges is to design and conduct joint field observation studies carried out by experts in robotics and social sciences. The joint analysis of these field studies will have an impact on the design of new theories, models, and algorithms, taking into account the human and societal aspects of these challenges. In the first part of the project, the consortium will focus on mobile manipulators, using platforms readily available within the consortium to conduct experiments with humans in public spaces and workplaces. In the second part of the project, the consortium will broaden its scope of investigation to wearable robots, with a higher degree of embodiment and physical interaction. The objective is to inform the development of platforms in PI1, PI2, and PI3, and to identify bidirectional links with AS1, AS2, and AS4.

10.4.2 PEPR O2R: PI3

Participants: Serena Ivaldi, Pauline Maurice.

Program: PEPR

Project acronym: PI3

Project title: ASSISTMOV

Duration: January 2024 – December 2031

Coordinator: Franck Geffard (CEA)

Local coordinator: Serena Ivaldi

Abstract: The integrated PI3 project “ASSISTMOV,” composed of a multidisciplinary team in engineering and Human and Social Sciences (HSS), targets the use case of assistive robotics for movement assistance for people with disabilities. Through the development of a range of exoskeletons (for both lower and upper limbs), this project aims to achieve a disruptive technology enabling fluid interaction that is robust across a wide variety of environments and use cases, from rehabilitation to everyday life. The project will follow the philosophy proposed within this PEPR, whose goal is to rethink robot design from hardware to software in order to promote social adaptation and inclusion. Centered on a holistic vision of use within its ecosystem, this innovative approach integrating HSS will question the relevance of existing and projected technological directions, whether for upper-limb (UL) or lower-limb (LL) applications. The objectives are to propose socially adapted robotic demonstrators (Challenge 1) while ensuring fluid interaction (Challenge 3), based on a hardware and software architecture that is robust across a variety of environments and use cases (Challenge 2).

10.4.3 ANR: OSTENSIVE

Participants: Serena Ivaldi, Enrico Mingo Hoffman.

Program: ANR

Project acronym: OSTENSIVE

Project title: Ostensive Human-Robot Interaction

Duration: April 2025 – April 2028

Coordinator: Mohamed Chetouani (Sorbonne Université)

Local coordinator: Serena Ivaldi

Abstract: When humans demonstrate a task to another human or agent, they go beyond merely manipulating the targeted object (instrumental action) to add to their actions ostensive communicative cues such as eye gaze and/or modulations of the demonstrations in the space–time dimensions (belief-directed action). This modulation results in behaviors that might appear to be sub-optimal, such as pause, repetition and exaggeration, but they are provided to communicate additional information. Recent research in Cognitive Science addressed this challenge of communication in action. Similarly, when robots have to perform actions, there is a need for mechanisms of communication in action allowing to combine instrumental and belief-directed actions. In robotics, this is known as the instantiation of legible robot motion (transparency through motion) by which a robot communicates its intent to a human observer. OSTENSIVE will provide novel solutions to study and develop human-robot interaction systems that are conceptually human centric by explicitly combining instrumental and belief-directed dimensions at key stages such as human behavior perception, human/robot motion representations, robot motion synthesis and simulation to real transfer. We will consider several approaches for (de)coupling instrumental and belief-directed actions by leveraging research in cognitive science and exploiting multi-task learning in order to explicitly consider dual components of human and robot actions.

10.4.4 ANR: BUCOLYC

Participants: Jean-Baptiste Mouret, Thomas Martin.

Program: ANR

Project acronym: BUCOLYC

Project title: Papillons et drones en conditions de vol confiné : aérodynamique, biomimétisme et IA au service du contrôle et de la stabilisation

Duration: September 2023 – August 2027

Coordinator: Mickaël Bourgoïn

Local coordinator: Jean-Baptiste Mouret

Abstract: While drone technology has matured for open-air flight, confined flight remains a major challenge, due to the aerodynamic interference induced by the complex couplings between the drone itself and the surrounding walls, which cause severe flight disturbances. This renders the usual unmanned aerial vehicles (UAV) stabilization controls inoperative, and considerably reduces maneuverability. Our project aims to address this challenge by combining aerodynamic, biomimetic and machine learning approaches to improve UAV control and stability in confined, near-wall environments. To achieve this ambitious goal, our multidisciplinary consortium brings together experts in robotics and biorobotics, fluid mechanics and entomologists, as well as an industrial partner (XTim) recognized for its leadership in the market for biomimetic flapping-wing drones.

10.4.5 Inria-AID (DGA): ATOR

Participants: Jean-Baptiste Mouret, Serena Ivaldi, Konstantinos Tsakonas, Clemente Donoso.

Program: Convention Inria-DGA

Project acronym: ATOR

Project title: Assisted Tele-Operation of Robots

Duration: January 2024 — December 2028

Coordinator: Jean-Baptiste Mouret

Abstract: The ATOR project aims at leveraging artificial intelligence algorithms to make it easier to teleoperate robots (typically mobile manipulators). The main idea is to exploit a dataset of expert demonstrations to guide the hand of a non-expert, helping to understand in real-time “what would an expert do in that situation”. The project will propose novel, uncertainty-aware trajectory prediction algorithms, as well as demonstrations with the robots of the team.

10.4.6 ANR: MERLIN

Participants: Enrico Mingo Hoffman, Fabio Amadio, Ioannis Tsikelis, Serena Ivaldi.

Program: ANR JCJC

Project acronym: MERLIN

Project title: Multi-limbed Robots empowered by whole-body Loco-manipulation.

Duration: April 2024 – October 2028

Coordinator: Enrico Mingo Hoffman

Summary: The MeRLin project aims to advance robotics for hazardous and physically demanding industrial tasks by enabling multi-limbed robots to operate safely and effectively in unstructured, dynamic environments. It proposes a robot-agnostic framework centered on whole-body planning and control, allowing robots to coordinate locomotion and manipulation through contact-rich interactions. The project integrates model-based optimization methods, which ensure stability and feasibility, with deep reinforcement learning, which provides adaptability and robustness to environmental uncertainty. This learning-augmented approach supports efficient long-term planning, fast-reacting control, and improved learning performance, aligning with growing industrial interest in humanoid and multi-limbed robots.

10.4.7 ANR: ROOIBOS

Participants: Pauline Maurice.

Program: ANR JCJC

Project acronym: ROOIBOS

Project title: User-Specific Adaptation of Collaborative Robot Motion for Improved Ergonomics

Duration: March 2021 – December 2025

Coordinator: Pauline Maurice (CNRS)

Summary: Collaborative robots have the potential to reduce work-related musculoskeletal disorders not only by decreasing the workers' physical load, but also by modifying and improving their postures. Imposing a sudden modification of one's movement can however be detrimental to the acceptance and efficiency of the human-robot collaboration. In ROOIBOS, we will develop a framework to plan user-specific trajectories for collaborative robots, to gradually optimize the efficiency of the collaboration and the long-term occupational health of the user. We will use machine learning and probabilistic methods to perform user-specific prediction of whole-body movements. We will define dedicated metrics to evaluate the movement ergonomic performance and intuitiveness. We will integrate those elements in a digital human simulation to plan a progressive adaptation of the robot motion accounting for the user's motor preferences. We will then use probabilistic decision-making to adapt the plan on-line to the user's motor adaptation capabilities. This will enable a smooth deployment of collaborative robots at work.

10.4.8 ANR: Ex-Aequo

Participants: Pauline Maurice.

Program: ANR JCJC

Project acronym: Ex-Aequo

Project title: Exoskeletons and firefighters: homogenizing capabilities and reducing constraints (physical, cognitive, organizational)

Duration: February 2025 – January 2029

Coordinator: Sophie Lemonnier (Perseus laboratory, University of Lorraine)

Summary: Firefighters have to perform particularly complex tasks that are both physically and cognitively demanding, especially when they involve carrying heavy loads (e.g., extrication, stretcher). Despite firefighters' rigorous training, this poses two major problems: 1/ Differences in morphology (e.g., the gender effect) lead to a number of situational and organizational problems; 2/ Physical and cognitive fatigue are present, leading in the long term to the development of musculoskeletal disorders (MSD).

The solution envisaged as part of this project involves the use of an exoskeleton as an aid in carrying out certain tasks. In order to evaluate this solution from different angles, and also with the aim of systematizing the method for evaluating the exoskeleton solution, the work will be structured according to three objectives.

Objective 1 aims to characterize the population (socio-demographic data, acceptability) and the tasks (activity analysis), and to select the exoskeleton for further use.

Objective 2 aims to experimentally evaluate the impact of using the exoskeleton. Physical and cognitive measurements will be taken to compare conditions with and without the exoskeleton, depending on the differences in the morphology of the participants (general public and firefighters). Objective 3 aims to formulate specific recommendations for firefighters, as well as developing two decision-support tools for making recommendations on the integration of an exoskeleton generalized to other work situations: a questionnaire evaluation and a digital simulation.

This work will have scientific spin-offs as well as a strong societal impact, making a first step towards greater inclusion and less occupational risk for firefighters, generalized to other professions via decision-support tools.

10.4.9 COMS@N: EXOCODESIM

Participants: Serena Ivaldi, Pauline Maurice.

Program: COMS@N Appel à Pré-Maturation

Project acronym: EXOCODESIM

Project title: Exoskeleton Co-design by Simulation

Duration: October 2024 – September 2025

Coordinator: Serena Ivaldi

Local coordinator: Serena Ivaldi

Abstract: We wish to develop our own prototypes of exoskeletons. This grant allows to hire two engineers for 1 year, to develop exoskeleton prototypes and validate them with simulation tools. The project results are transferred to a startup of the team, led by Raphael Bousigues and Raphael Lartot - they are currently incubated at Inria Startup Studio.

10.5 Regional initiatives

10.5.1 LUE: EXOSIM

Participants: Pauline Maurice, Serena Ivaldi.

Program: LUE

Project acronym: EXOSIM

Project title: Simulation de tâches pénibles couramment réalisées en milieu hospitalier pour guider la recherche automatique de solutions exosquelettes pour assister les soignants

Duration: July 2024 – July 2026

Coordinator: Serena Ivaldi

Summary: Following the previous ExoTurn and ExoCare projects coordinated by Serena Ivaldi and Prof. Nicola Settembre, we wish to continue the collaboration between Inria/Loria and the Nancy University Hospital (CHRU de Nancy) in the use of digital tools to support the introduction, experimentation, and deployment of exoskeletons in healthcare settings. In this project, we aim to develop a new program for the development of digital tools to: 1) help the hospital identify existing exoskeletons that could potentially be relevant for assisting healthcare workers, or, failing that, to define the specifications for a new exoskeleton to be acquired, through a physical simulation software of a virtual human and ergonomic evaluation developed by Inria/Loria; 2) have the software validated by the ergonomists of CHRU de Nancy, as well as the choice of the device; 3) equip the hospital with digital instruments integrating both subjective evaluation (via questionnaires) and objective evaluation (via wearable sensors) to monitor the experimental campaign for testing exoskeletons in the short, medium, and long term, using these data to guide the exoskeleton adoption process.

10.6 Public policy support

- Serena Ivaldi contributed to the writing of the **SRA (Strategic Research Agenda)** related to robotics and AI for the European Commission, in the context of the euROBIN project (Network of Excellence)
- Jean-Baptiste Mouret was interim coordinator of the ENACT Cluster IA project, having a significant impact to the political decisions in the Grand Est Region about AI.

11 Dissemination

11.1 Promoting scientific activities

11.1.1 Scientific events: organisation

General chair, scientific chair

- Serena Ivaldi organized, in the context of PEPR O2R AS3, a one-day conference «**Robots sociaux, design de robot et design d'interaction : un dialogue entre robotique, art et design**», at Cité des Sciences, Paris, in June 2025. Half-day was open to the general public.
- Maria Elisabetta Zibetti organized, in the context of PEPR O2R AS3, a half-day conference **IA, Art et Robotique** at LUTIN - Cité des Sciences, Paris, in December 2025.

Member of the organizing committees

- Enrico Mingo Hoffman was part of the organization of the **Optimization for Robotics Summer School** held at the University of Patras, Greece, from the 14th to 18th of July 2025. He was part of the Organizing Committee of the 28th issue of the International Conference Series on Climbing and Walking Robots and the Support Technologies for Mobile Machines (CLAWAR) 2025, as Special/Workshop Session Chair.

Workshops organization

- Pauline Maurice was co-organizer of a workshop on "AI-Powered Human Modeling for Healthcare Robotics" at IEEE/RSJ IROS 2025.
- Serena Ivaldi and Dionis Totsila co-organized the [HUMANOIDS 2025 Workshop on Foundation Models for Humanoid Robots](#).

Other

- Maria Elisabetta Zibetti organised a 1-day visit and scientific meeting with David St-Onge (ETS Montreal) and Samuel Bianchini (ENSAD Paris) in our lab, to discuss about robotics, design and behavior, and possible collaborations.

11.1.2 Scientific events: selection

Member of the conference program committees

- Pauline Maurice was an Associate Editor for IEEE-RSJ IROS 2025, IEEE-RAS Humanoids 2025 and IEEE-RAS ICRA 2026.
- Enrico Mingo Hoffman was an Associate Editor for IEEE-RSJ IROS 2025, IEEE-RAS Humanoids 2025 and IEEE-RAS ICRA 2026 (conference). He also served as Chair of the IEEE HUMANOIDS 2025 *Oral Session 1* and chaired the keynote speech of Prof. Shuran Song. At the same conference he was also part of the Review Committee for the Best Oral, Best Interactive, and Mike Stillman awards.
- Serena Ivaldi was an Associate Editor for ARSO 2025 and ICRA 2026.
- Guillaume Bellegarda was an Associate Editor for ICRA 2026.

Reviewer

- Serena Ivaldi was a reviewer for ARSO 2025, HRI 2025, ICRA 2026, IROS 2025.
- Guillaume Bellegarda was a reviewer for RSS 2025, IROS 2025, CORL 2025, Humanoids 2025, CLAWAR 2025, ECC 2026, CVPR 2026.

11.1.3 Journal

Member of the editorial boards

- Pauline Maurice is associate editor for IEEE Transactions on Neural Systems and Rehabilitation Engineering (TNSRE).
- Enrico Mingo Hoffman is associate editor for the International Journal of Robotics Research (IJRR), and for the IEEE Robotics and Automation Letters Special Issue on Advancements in MPC and Learning Algorithms for Legged Robots.
- Jean-Baptiste Mouret is a member of the editorial board of NPJ Robotics.
- Jean-Baptiste Mouret is an associate editor of ACM Transactions on Evolutionary Computation and Learning
- Serena Ivaldi is associate editor for IEEE Transactions on Robotics (T-RO).
- Guillaume Bellegarda is an associate editor for IEEE Robotics and Automation Letters Special Issue on Advancements in MPC and Learning Algorithms for Legged Robots.

Reviewer - reviewing activities

- Pauline Maurice reviewed articles for IEEE Transactions on Robotics, IEEE Robotics and Automation Letters, the International Journal of Robotics Research, IEEE Transactions on Human-Machine Systems.
- Enrico Mingo Hoffman reviewed articles for IEEE Transactions on Robotics, IEEE Robotics and Automation Letters, and the International Journal of Robotics Research.
- Serena Ivaldi was a reviewer for Scientific Reports and Transactions on HRI.
- Guillaume Bellegarda was a reviewer for IEEE Transactions on Robotics, IEEE Robotics and Automation Letters, Science Robotics, IEEE Transactions on Field Robotics.

11.1.4 Invited talks

- Pauline Maurice gave an invited talk at the seminar "Mechatronics Days" of ENS Rennes (France), in a workshop on "Enhancing Human Intuition and Robotic Precision with Optimization-Driven Shared Autonomy" at JNRR 2025 (France), and in a workshop on "Simulated and XR Environments for Ergonomics and Physical Assistance" of the conference PREMUS 2025 (Germany).
- Serena Ivaldi was keynote speaker at the international conference IEEE Telepresence 2025.
- Serena Ivaldi was keynote speaker at the IEEE RAS [Optimization for Robotics Summer School](#).
- Serena Ivaldi gave an invited talk about robotics & AI at the European Cyber Week 2025 in Rennes (France).
- Dionis Totsila gave an invited talk at the HUMANOIDS 2025 Workshop on Assistive Robots for Caregiving, titled "Enabling simple interactions with assistive robots using natural language".
- Guillaume Bellegarda gave two invited talks at the ELLIIT 2025 Robot Learning Focus Period in Lund (Sweden), one seminar "Deep Learning, Optimal Control, and Bio-Inspired Control for Dynamic Robots", and one course lecture "Legged Locomotion: Trajectory Optimization, Machine Learning, Bio-Inspired Control".
- Guillaume Bellegarda gave a lecture at the Legged Robots masters course at EPFL (Switzerland) on "Legged Locomotion: Trajectory Optimization, Machine Learning, Bio-Inspired Control".
- Enrico Mingo Hoffman gave a lecture on optimal control, "From Reactive to Predictive Control", with practicals (in total 2h) at the Summer School on Optimization for Robotics, Univ. of Patras, Greece.
- Enrico Mingo Hoffman gave a lecture on closed loop kinematics chains for the Underactuated Robotics course at the Univ. of Rome "La Sapienza", Italy.

11.1.5 Leadership within the scientific community

- Pauline Maurice is a co-chair of the technical committee on "Humans and Robots" of the French GdR Robotique.
- Enrico Mingo Hoffman was Corresponding Chair of the IEEE-RAS Technical Committee on "Whole-Body Control", now a co-chair for end of mandate (3 years).
- Serena Ivaldi was Associate Vice-President of IEEE Robotics & Automation Society (RAS) Members Activities Board (MAB); she was also Senior Program Committee Member for the HUMANOIDS 2025 conference as part of the IEEE HUMANOIDS Steering Committee.

11.1.6 Scientific expertise

- Enrico Mingo Hoffman served as an expert evaluator for the ARISE 1st Open Call proposals 2025 for the EU-funded project ARISE. He was also invited to participate to the panel discussion "Mobile Manipulation of rigid and deformable objects: Community Challenges and Opportunities" at the European Robotics Forum (ERF) 2025.
- Serena Ivaldi was an expert reviewer for: ANR (Industrial Chair + AAPG 2025); ANRT for a CIFRE thesis; ENACT Cluster IA for a PhD selection jury; ERC Advanced for one project; EUropean Commission to review the European Project FELICE; University of Massachusset Amherst to evaluate the tenure of an Associate professor. She was also invited as expert in robotics to private events for two companies: one French leader in logistics, one French leader in the luxury industry.

11.1.7 Research administration

- Jean-Baptiste Mouret was "Délégué Scientifique" (head of science) of the Inria center of the University of Lorraine.
- Jean-Baptiste Mouret was the scientific coordinator of the ENACT Cluster-IA project from 07/2025.
- Jean-Baptiste Mouret was vice-president of the hiring committee for the permanent research positions (CRCN and ISFP) at the Inria center of the University of Lorraine.
- Jean-Baptiste Mouret was member of the Evaluation Commission of Inria (as a "Délégué scientifique")
- Serena Ivaldi was coordinator of the PEPR O2R AS3 project.

11.2 Teaching - Supervision - Juries - Educational and pedagogical outreach

11.2.1 Teaching

- Master: Serena Ivaldi and Anna Bucchieri, "Analyse Comportementale", 20h CM/TP, M2 "Sciences Cognitives", Univ. Lorraine, France. – (2024/2025 done by Serena Ivaldi, 2025/2026 done by Anna Bucchieri)
- Master: Pauline Maurice, "Analyse Comportementale", 15h CM/TP, M2 "Sciences Cognitives", Univ. Lorraine, France.
- Master: Pauline Maurice, "Robotic assistive devices for occupational applications: From research to deployment", 9h CM/TP, 3rd year (M2) in "Control Engineering", Centrale-Supelec, France.
- Master: Pauline Maurice, "Human motion analysis for human-robot interaction", 6h CM, M2 Robotics and Biomechanics (joint class), Univ. of Lyon, France.
- Bachelor: Enrico Mingo Hoffman, "Operation Research", 18 h, Civil Engineering, Mines, Univ. Lorraine, France.
- Bachelor: Enrico Mingo Hoffman, "Introduction to Robotics", 7 h, Civil Engineering, Mines, Univ. Lorraine, France.

11.2.2 Supervision

- PhD: Alexandre Oliveira Souza, "Intelligence Artificielle et contrôle de systèmes interactifs : Application aux exosquelettes", started in May 2022, defended in Septembrer 2025, François Charpillet (advisor), Pauline Maurice (co-advisor), Serena Ivaldi (co-advisor), CIFRE with Safran.
- PhD in progress: Aya Yaacoub, "User-specific planning of a collaborative robot behavior to help prevent musculoskeletal disorders", started in December 2021 (defense planned for February 2026), Francis Colas (advisor), Pauline Maurice (co-advisor), Vincent Thomas (co-advisor), ROOIBOS project.

- PhD in progress: Ioannis Tsikelis, “Whole-Body planning, control and learning for loco-manipulation actions”, started in October 2024, Serena Ivaldi (co-advisor), Enrico Mingo Hoffman (co-advisor), MeRLin project.
- PhD in progress: Ioannis Loizou, “Generation of expressive motions for humanoid robots”, started in October 2025, Serena Ivaldi (co-advisor), Enrico Mingo Hoffman (co-advisor), OSTENSIVE project.
- PhD in progress: Thomas Martin, “Utilisation de l’apprentissage automatique pour le vol de drones en milieu très confiné”, started in January 2024, Jean-Baptiste Mouret (advisor) and Thibaut Rahajiraona (co-avisor), BUCOLYC project.
- PhD in progress: Konstantinos Tsakonas, “Intelligence artificielle pour la prédiction de trajectoires en robotique téléopérée”, started in October 2024, Serena Ivaldi (advisor) and Jean-Baptiste Mouret (co-advisor), ATOR project.
- PhD in progress: Mathis Antonetti, “Diffusion pour l’apprentissage de politiques de manipulation en robotique”, started in December 2024, Serena Ivaldi (advisor) and Jean-Baptiste Mouret (co-advisor), La Poste project.
- PhD in progress: Georgios Kalakonis, “Données synthétiques pour l’entraînement de modèles multi-modaux Vision-Language-Actions pour des robots généralistes”, started in December 2025, Jean-Baptiste Mouret (advisor) and Enrico Mingo Hoffman (co-advisor), ENACT project.
- PhD in progress: Quentin Rolland, “Utilisation de méthodes de détection d’anomalies “one class” pour entraîner un robot par apprentissage par démonstration”, Jean-Baptiste Mouret (advisor) and Fabrice Mayran de Chamisso (co-avisor, CEA), PhD with CEA.
- PhD in progress: Dionis Totsila, “Apprentissage de gestes bi-manuels par démonstration des humains et langage naturel”, Serena Ivaldi (advisor) and Jean-Baptiste Mouret (co-advisor), euROBIN project.

11.2.3 Juries

- Pauline Maurice was
 - Examiner of the PhD of Clément Thevenot (Devah, University of Lorraine)
 - Examiner of the PhD of Alexandre Schortgen (INRIA Grenoble, University Grenoble Alpes)
 - Examiner of the PhD of Maxime Sabbah (LAAS, University of Toulouse)
 - Examiner of the PhD of Idriss Pelletan (Museum National d’Histoire Naturelle)
 - Examiner of the PhD of Maxime Marchal (Vrije Universiteit Brussel, Belgium)
 - Member of the hiring committee for an Assistant Professor position at Ecole Nationale d’Ingénieurs de Metz (CNU 61)
 - Member of the hiring committee for an Assistant Professor position at Université de Technologie Tarbes Occitane Pyrénées (CNU 61)
- Enrico Mingo Hoffman was member of the examination panel for the PhD thesis defense of Juan Hernandez Vicen, Universidad Carlos III de Madrid.
- Serena Ivaldi was:
 - Examiner of the PhD of Maria Valentina Cavarretta (University of Palermo & Université Paris 8)
 - Examiner & President of the Jury of the PhD of Clélie Amiot (University of Lorraine)
 - Reviewer of the PhD of Aymeric Orhan (Université Paris-Saclay)
 - Examiner & President of the Jury of the PhD of Fabio Elnecape Xavier (Université Paris PSL & Mines Paris)

- Examiner of the PhD of Robin Gigandet (Université de Lille)
- Examiner & President of the Jury of the PhD of Ricardo Garcia-Pinel (Université Paris PSL & Inria)
- Member of 3 CSI: Alessia Fusco (LAAS), Augustin Chartouny (ISIR), Bastien Muraccioli (CNRS-AIST).
- Member of the hiring committee for a Full Professor at Université de Lorraine.

11.3 Popularization

11.3.1 Productions (articles, videos, podcasts, serious games, ...)

- Serena Ivaldi was interviewed by and appeared on Planete Robots, Le Parisien, Usine Nouvelle, Le Point, Science et Vie, L'Europe, France Info, TF1.
- Jean-Baptiste Mouret was interviewed by and appeared on Planete Robot, Le Journal du Net.
- Enrico Mingo Hoffman was interviewed by and appeared on Science & Vie ("Le mécha : un robot géant vite encombrant") and Le Parisien ("VIDÉO. « Ces images sont vraies » : EngineAI, l'entreprise chinoise qui a semé le trouble avec son robot T-800").

11.3.2 Participation in Live events

- Pauline Maurice participated in an event from "Les Décodeuses du Numérique" organized by CNRS Sciences Informatiques in Paris, to present the work of female researchers in digital sciences to high school students.
- Enrico Mingo Hoffman participated in an event at Viva tech 2025 entitled "Global Talent, French Future: Stories of AI Researchers in France"

11.3.3 Others science outreach relevant activities

- Pauline Maurice participated in a podcast for children (Mission Info of France TV), to promote women in science.

12 Scientific production

12.1 Major publications

- [1] T. Martin, A. Guénard, V. Tempez, L. Renaud, T. Raharijaona, F. Ruffier and J. B. Mouret. 'Flying in air ducts'. In: *npj Robotics* 3.16 (13th June 2025). DOI: [10.1038/s44182-025-00032-5](https://doi.org/10.1038/s44182-025-00032-5). URL: <https://hal.science/hal-04775869>.
- [2] A. Oliveira Souza, J. Grenier, F. Charpillet, P. Maurice and S. Ivaldi. 'Towards data-driven predictive control of active upper-body exoskeletons for load carrying'. In: *2023 IEEE International Conference on Advanced Robotics and Its Social Impacts (ARSO)*. International Conference on Advanced Robotics and its Social Impacts. Berlin, Germany, 2023. DOI: [10.1109/ARSO56563.2023.10187548](https://doi.org/10.1109/ARSO56563.2023.10187548). URL: <https://hal.science/hal-04087475>.
- [3] Q. Rouxel, C. Donoso, F. Chen, S. Ivaldi and J.-B. Mouret. 'Extremum Flow Matching for Offline Goal Conditioned Reinforcement Learning'. In: *2025 IEEE-RAS 24th International Conference on Humanoid Robots (Humanoids)*. Seoul, South Korea, 27th Sept. 2025. URL: <https://inria.hal.science/hal-05080807>.
- [4] Q. Rouxel, S. Ivaldi and J.-B. Mouret. 'Multi-Contact Whole-Body Force Control for Position-Controlled Robots'. In: *IEEE Robotics and Automation Letters* 9.6 (1st May 2024), pp. 5639–5646. DOI: [10.1109/LRA.2024.3396094](https://doi.org/10.1109/LRA.2024.3396094). URL: <https://hal.science/hal-04362547>.

- [5] A. Yaacoub, V. Thomas, F. Colas and P. Maurice. ‘A Probabilistic Model for Cobot Decision Making to Mitigate Human Fatigue in Repetitive Co-manipulation Tasks’. In: *IEEE Robotics and Automation Letters* (14th Sept. 2023). DOI: [10.1109/LRA.2023.3315583](https://doi.org/10.1109/LRA.2023.3315583). URL: <https://hal.science/hal-04209954>. In press.

12.2 Publications of the year

International journals

- [6] A. Billard, A. Albu-Schaeffer, R. Alami, T. Asfour, S. Ivaldi, C. Leroux, D. Kragic, A. R.-v. D. Pütten, N. Nosengo and C. Sabelli. ‘Human–Robot Interaction: Successes, Hurdles, and Remaining Challenges [Opinion]’. In: *IEEE Robotics and Automation Magazine* 32.4 (2025), pp. 101–106. DOI: [10.1109/MRA.2025.3619329](https://doi.org/10.1109/MRA.2025.3619329). URL: <https://hal.science/hal-05448964>.
- [7] M. Edraki, H. Serré, P. Maurice and D. Sternad. ‘Force-velocity coupling limits human adaptation in physical human–robot interaction’. In: *Scientific Reports* (16th Jan. 2026). DOI: [10.1038/s41598-025-34959-4](https://doi.org/10.1038/s41598-025-34959-4). URL: <https://hal.science/hal-05466871>.
- [8] J. Juancastano, E. M. Espuela, J. R. Rojas, E. M. Hoffman and C. Zhou. ‘Benchmarking Standing Stability for Bipedal Robots’. In: *IEEE Access* 13 (2025), pp. 1–1. DOI: [10.1109/ACCESS.2025.3529191](https://doi.org/10.1109/ACCESS.2025.3529191). URL: <https://hal.science/hal-04843410>.
- [9] T. Martin, A. Guénard, V. Tempez, L. Renaud, T. Raharijaona, F. Ruffier and J. B. Mouret. ‘Flying in air ducts’. In: *npj Robotics* 3.16 (13th June 2025). DOI: [10.1038/s44182-025-00032-5](https://doi.org/10.1038/s44182-025-00032-5). URL: <https://hal.science/hal-04775869>.
- [10] F. Ruscelli, L. Rossini, E. M. Hoffman, L. Baccelliere, A. Laurenzi, L. Muratore, D. Antonucci, S. Cordasco and N. G. Tsagarakis. ‘Design and Control of the Humanoid Robot COMAN+: Hardware Capabilities and Software Implementations’. In: *IEEE Robotics and Automation Magazine* 32.1 (2025), pp. 2–13. DOI: [10.1109/MRA.2024.3505773](https://doi.org/10.1109/MRA.2024.3505773). URL: <https://hal.science/hal-04876463>.
- [11] A. Suarez, R. Kartmann, D. Leidner, L. Rossini, J. Huber, C. Azevedo, Q. Rouxel, M. Bjelonic, A. Gonzalez-Morgado, C. Dreher et al. ‘Door-to-Door Parcel Delivery From Supply Point to User’s Home With Heterogeneous Robot Team: The euROBIN First-Year Robotics Hackathon’. In: *IEEE Robotics and Automation Magazine* 32.3 (Sept. 2025), pp. 8–25. DOI: [10.1109/MRA.2024.3501954](https://doi.org/10.1109/MRA.2024.3501954). URL: <https://hal.science/hal-05313286>.
- [12] D. Totsila, K. Chatzilygeroudis, V. Modugno, D. Hadjiveličkov and D. Kanoulas. ‘Sensorimotor Learning With Stability Guarantees via Autonomous Neural Dynamic Policies’. In: *IEEE Robotics and Automation Letters* 10.2 (Feb. 2025), pp. 1760–1767. DOI: [10.1109/LRA.2024.3524878](https://doi.org/10.1109/LRA.2024.3524878). URL: <https://inria.hal.science/hal-04913600>.

International peer-reviewed conferences

- [13] A. Bucchieri, S. Ivaldi and P. Maurice. ‘Preliminary Comparison of Inverse Dynamics and Quadratic Programming control for Motion Tracking in Digital Human Models’. In: 47th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBS2025). Copenhagen, Denmark, 14th July 2025. URL: <https://hal.science/hal-05049695>.
- [14] T. Martin, J. Roman Blanco, J.-B. Mouret and T. Raharijaona. ‘Compact docking for precise indoor drone landing’. In: 26ème Congrès Français de Mécanique (CFM 2025). Metz, France, 2025. URL: <https://hal.science/hal-05312914>.
- [15] Q. Rouxel, C. Donoso, F. Chen, S. Ivaldi and J.-B. Mouret. ‘Extremum Flow Matching for Offline Goal Conditioned Reinforcement Learning’. In: 2025 IEEE-RAS 24th International Conference on Humanoid Robots (Humanoids). Seoul, South Korea, 27th Sept. 2025. URL: <https://inria.hal.science/hal-05080807>.

- [16] N. Scianca and E. M. Hoffman. ‘CPC: Cascaded Predictive Control’. In: *2025 IEEE-RAS 24th International Conference on Humanoid Robots (Humanoids)*. 2025 IEEE-RAS 24th International Conference on Humanoid Robots. Seoul, South Korea: IEEE, 30th Sept. 2025, pp. 237–244. DOI: [10.1109/Humanoids65713.2025.11203075](https://doi.org/10.1109/Humanoids65713.2025.11203075). URL: <https://hal.science/hal-05070222>.
- [17] A. O. Souza, F. Charpillat, S. Ivaldi and P. Maurice. ‘Physics-based simulation for motion prediction in active exoskeleton control’. In: *PREMUS 2025: 12th International Scientific Conference on the Prevention of Work-Related Musculoskeletal Disorders*. 12th International Scientific Conference on the Prevention of Work-Related Musculoskeletal Disorders (PREMUS 2025). Vol. Symposium SYM 1. Tübingen, Allemagne, Germany: German Medical Science GMS Publishing House, 9th Sept. 2025, Doc153. DOI: [10.3205/25premus153](https://doi.org/10.3205/25premus153). URL: <https://hal.science/hal-05423692>.
- [18] D. Totsila, C. Donoso, E. M. Hoffman, J.-B. Mouret and S. Ivaldi. ‘Safe Bimanual Teleoperation with Language-Guided Collision Avoidance’. In: *2025 IEEE Conference on Telepresence*. Leiden (Netherlands), Netherlands, 8th Sept. 2025. URL: <https://inria.hal.science/hal-05123517>.
- [19] I. Tsikelis, E. Tsiatsianas, C. Kiourt, S. Ivaldi, K. Chatzilygeroudis and E. M. Hoffman. ‘AHMP: Agile Humanoid Motion Planning With Contact Sequence Discovery’. In: *Humanoids 2025 : 2025 IEEE-RAS 24th International Conference on Humanoid Robots*. Seoul, South Korea: IEEE, 30th Sept. 2025, pp. 33–40. DOI: [10.1109/Humanoids65713.2025.11203211](https://doi.org/10.1109/Humanoids65713.2025.11203211). URL: <https://hal.science/hal-05072261>.

Conferences without proceedings

- [20] F. Amadio, H. Li, L. Uttini, D. Kanoulas, S. Ivaldi, V. Modugno and E. Mingo Hoffman. ‘Learning to Walk with Hybrid Serial-Parallel Linkages: a Case Study on the Kangaroo Robot’. In: *13th International Conference on Robot Intelligence Technology and Applications*. London, United Kingdom, 17th Dec. 2025. URL: <https://hal.science/hal-05072198>.
- [21] A. Bucchieri, S. Ivaldi and P. Maurice. ‘Quadratic-programming based simulation for human movement analysis’. In: *SB 2025 - 50ème congrès de la Société de Biomécanique*. Marseille, France, 27th Oct. 2025. URL: <https://inria.hal.science/hal-05229492>.
- [22] F. Cufino, M. Selvaggio, F. Amadio and F. Ruggiero. ‘Compliant Non-Prehensile Pushing Manipulation’. In: *IRIM-3D 2025: 7th Italian Conference on Robotics and Intelligent Machines*. Rome, Italy, 17th Oct. 2025. URL: <https://hal.science/hal-05411011>.
- [23] A. O. Souza, A. Bucchieri, F. Charpillat, S. Ivaldi and P. Maurice. ‘ExoSim: Towards Physics-Based Modeling and Validation of Human-Exoskeleton Interaction’. In: *DAWR 2025 - IEEE EMBC Workshop - Design and Assessment Wearable Robotics*. Copenhagen, Denmark, 16th July 2025. URL: <https://hal.sorbonne-universite.fr/hal-05184804>.
- [24] J. Wacquez, E. Zibetti, J. Becker, L. Aloe, F. Amadio, S. Anzalone, L. Cañamero and S. Ivaldi. ‘What Can Robots Teach Us About Trust and Reliance? An interdisciplinary dialogue between Social Sciences and Social Robotics’. In: *18th International Workshop on Human-Friendly Robotics 2025, HFR 2025*. Capri Island, Italy, 15th June 2025. URL: <https://hal.science/hal-05157054>.

Other scientific publications

- [25] I. Loizou. ‘Humanoid Bipedal Locomotion through Linear Model Predictive Control’. Centrale Nantes, 20th Aug. 2025, p. 62. URL: <https://hal.univ-lorraine.fr/hal-05297772>.
- [26] T. Martin, A. Guénard, V. Tempez, L. Renaud, T. Raharijaona, F. Ruffier and J.-B. Mouret. *Flying in air ducts*. 13th June 2025. DOI: [10.1038/s44182-025-00032-5](https://doi.org/10.1038/s44182-025-00032-5). URL: <https://inria.hal.science/hal-05111488>.

Patents

- [27] D. Totsila, S. Ivaldi, J.-B. Mouret and C. Donoso Krauss. ‘Système d’interaction robotique’. FR2513437 (France). 17th Nov. 2025. URL: <https://hal.science/hal-05420488>.

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- [28] A. Ajoudani, A. M. Zanchettin, S. Ivaldi, A. Albu-Schäffer, K. Kosuge and O. Khatib. ‘Progress and Prospects of the Human-Robot Collaboration’. In: *Autonomous Robots* (2017), pp. 1–17. DOI: [10.1007/s10514-017-9677-2](https://doi.org/10.1007/s10514-017-9677-2). URL: <https://hal.science/hal-01643655>.
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- [31] T. Anne, E. Dalin, I. Bergonzani, S. Ivaldi and J.-B. Mouret. ‘First Do Not Fall: Learning to Exploit a Wall With a Damaged Humanoid Robot’. In: *IEEE Robotics and Automation Letters* 7.4 (Oct. 2022), pp. 9028–9035. DOI: [10.1109/LRA.2022.3188884](https://doi.org/10.1109/LRA.2022.3188884). URL: <https://hal.science/hal-03740371>.
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