Research group
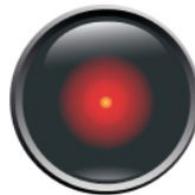
The research group is based on two contiguous and highly interacting labs:

- Evolutionary Robotics and Artificial Life lab (ERALLab, https://erallab.inginf.units.it/)
- Machine Learning lab (MaLeLab, https://machinelearning.inginf.units.it/)

Jointly, the group is currently composed of academic staff:

- Eric Medvet (associate professor, head of ERALLab)
- Alberto Bartoli (associate professor, head of MaLeLab)
- Andrea De Lorenzo (assistant professor)

PhD students:

- Jacopo Talamini, PhD student ERALLab
- Daniele Panfilo, PhD student MaLeLab

And master students:

- Giulio Fidel, master student ERALLab graduating in mid 2020
- Marco Catto, master student ERALLab graduating in mid 2020
- Marco Rochelli, master student ERALLab graduating in late 2020
- Matteo Leghissa, master student MaLeLab graduating in late 2020
- Federico Pigozzi, master student MaLeLab graduating in late 2020

Students and staff interact daily, with the goal of mutual enrichment resulting eventually, when possible, in research output.

Work to be carried out by the student

The student will work within the framework of the ReMoSo project, for which the advisor was recently assigned the **Google Faculty Research Award** 2020.

The project is the about the **optimization** of the design (body and brain) of a particular kind of simulated robots: the problem well fits **evolutionary computation** optimization techniques.

A description of the project follows. More info here:
https://erallab.inginf.units.it/voxel-based-soft-robots

ReMoSo: representations and learning algorithms for highly reconfigurable modular soft robots

Voxel-based soft robots (VSRs) are a kind of robots that are intrinsically modular and reconfigurable, being an aggregation of many simple soft blocks. These features make VSRs potentially suitable for solving a wide range of tasks, provided that their body and brain is tailored to the specific task. Optimization and learning can be the mean through which tailoring is obtained, but current algorithms and representations do not explicitly exploit the intrinsic modularity and reconfigurability of VSRs: a good VSR for a task might be obtained by automatically reusing parts of other VSRs that are good for other tasks. This project will pursue this goal: designing algorithms and representations for the optimization of modular and reconfigurable VSRs. Moreover, for facilitating results and boosting research in this field, software tools and benchmarks will be developed too and released openly.

Several research topics are to be investigated within this framework (see https://erallab.inginf.units.it/student-opportunities). The ones that are more suitable for a few months collaboration fitting the requirements and objectives of the SPECIES scholarships are likely:
- Resolution-agnostic representation for evolution of closed-loop controllers of VSRs
- Improving scalability of VSR controller learning with Covariance Matrix Adaptation Evolutionary Strategies (CMA-ES)
- Novelty in perception for driving optimization of VSRs controller

The visiting student will be able to select the topic based on her/his personal expertise and knowledge about evolutionary computation. She/he will exploit the advisor's and other students' (both PhD and master) experience on the topic; she/he will be able to use software tools ready to be used for the research (primarily [1]) and will hence have the opportunity to focus on algorithms and experiment design rather than in software development.

References

1. Medvet, Bartoli, De Lorenzo, Seriani, Design, Validation, and Case Studies of 2D-VSR-Sim, an Optimization-friendly Simulator of 2-D Voxel-based Soft Robots, arXiv, 2020 (https://github.com/ericmedvet/2dhmsr)

Other information

City of Trieste

Trieste is a mid-sized Italian city placed on the northernmost part of the Mediterranean sea. It is known for its high quality of life (5th in Italy according to Sole 24 Ore ranking) and its lively multiculturalism, deriving from its being a border town. Trieste is since decades a research and science city: it hosts 2 universities (University of Trieste and SISSA) and many world-level research institution. It will be the City of Science 2020 and will host the Euroscience Open Forum (ESOF2020) in early July 2020 (https://www.esof.eu/en/home.html)

Trieste is a researcher-friendly city: with its 37 researchers on 1000 inhabitants it is one of the most science-dense regions of the world. As a result, Trieste offers many facilities and accommodations for researchers and students (e.g., Welcome Office: http://www.welcomeoffice.fvg.it/).

Accommodation

University of Trieste offers many student services, including accommodation and use of the canteen, to its students: see http://www.welcomeoffice.fvg.it/practical-info/accommodation/students-and-researchers-hall/. Depending on the status of the visiting student, these services may be accessed at a discounted rate.