

PhD offer in "Reinforcement learning and global workspace for legged robots and mobile manipulator."

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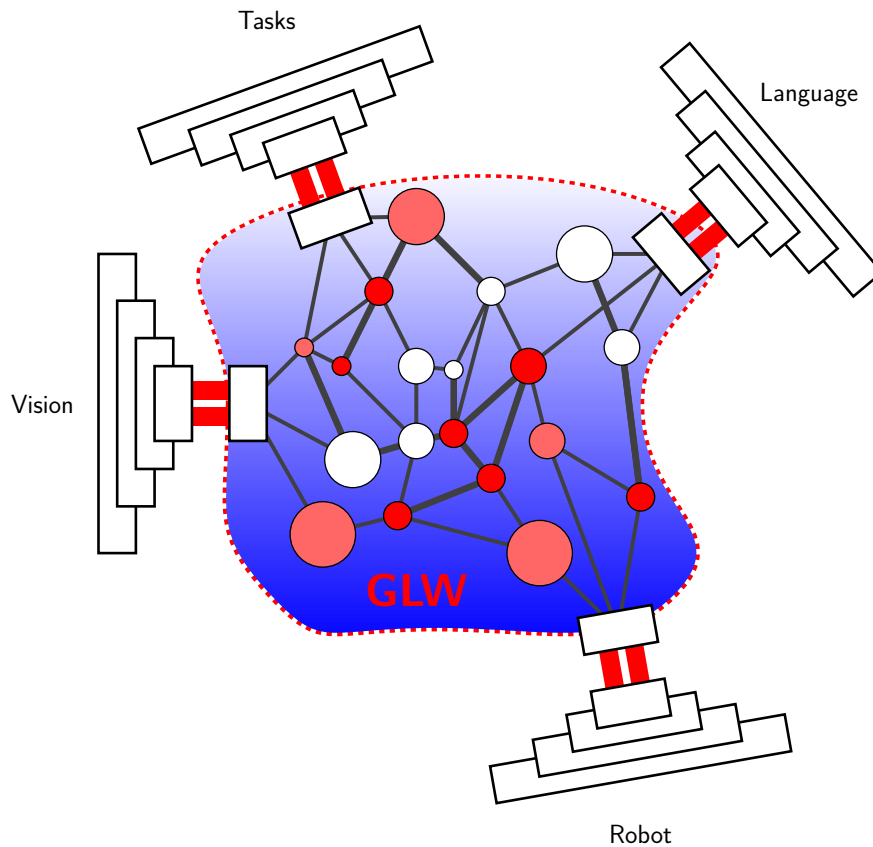


Figure 1: The Global Workspace (GLW) links through variable encodings various spaces: motion, vision, tasks, and language.

1 Goal

The goal of this PhD is to explore recent breakthrough in AI such that non robotics expert can uttered a phrase such as: "Bring me the screwdriver in the workbench" and the robot will autonomously realize the needed sequence of tasks.

2 Subject

The goal of this PhD, is to provide the robotics foundation for the concept of Global Workspace depicted in Fig.1. This concept is a theory of mind introduced in [1]. The PhD takes place in the "Cobots with Conversation, Cognition and PerceptiOn (C3-PO)" chair accepted in the frame of the Artificial and Natural Intelligence Toulouse Institute starting in 2024. The link with vision will be investigated with the team of Rufin Van Rullen [2], Thomas Serre . The link with Natural Language Processing will take place with the team of Nicolas Asher and Philippe Muller.

More specifically this PhD will provide the robotics side of the Global Workspace. The current state of the start will take its root in the recent advances on reinforcement learning applied to legged robots [3]. Indeed new tools such as Isaac Gym, are allowing now to test several years of real experiments in few hours of simulation. The Gepetto team has build upon such tool to generate highly dynamical motions on the open source SOLO robot [4]. The work will start by evaluating the recent results in visual-action-language frameworks such as Octo [5] or OpenVLA [6]. These two frameworks are based on the Open-X dataset [7] which contains almost no dataset for legged robots (only one A-1 unitree robot).

The PhD candidate is expected to interact with other PhD students investigating the link between model predictive control and reinforcement learning [8]. Indeed classical model based approach provides an interesting means to bootstrap and explore the space of possible trajectories for the robots. The PhD candidate will interact with other international chairs such as the one led by Ludovic Righetti NERL.

3 Context

Gepetto, LAAS is an international research environment and the working language is English. Located in the University town of Toulouse, in the south-west of France, the CNRS-LAAS (Laboratory for the analysis and architecture of systems) laboratory, a 640 man strong research center with about 90 people working in robotics. It benefits from strong connections to the adjoining universities and the space and aeronautics industry.

4 Qualifications:

- Master in robotics, machine learning, computer science, control, numerical optimization.
- Experience with deployment of control architecture on real robot
- Experience in code development: C++, python, github, cmake, ROS,

ROS/2, control architecture such as `ros\control`, OCS2, Crocodyl

- Experience on pratical deployment of machine learning

5 Bibliography

[1] B. Baars, "Global workspace theory of consciousness: toward a cognitive neuroscience of human experience," *Progress in brain research*, vol. 150, pp. 45–53, 2005.

[2] L. Maytié, B. Devillers, A. Arnold, and R. VanRullen, "Zero-shot cross-modal transfer of reinforcement learning policies through a global workspace," in *Reinforcement learning*, 2024.

[3] T. Miki, J. Lee, J. Hwangbo, L. Wellhausen, V. Koltun, and M. Hutter, "Learning robust perceptive locomotion for quadrupedal robots in the wild," *Science robotics*, vol. 7, no. 62, 2022, Available: <https://doi.org/10.48550/arXiv.2201.08117>

[4] E. Chane-Sane, P.-A. Leziart, T. Flayols, O. Stasse, P. Souères, and N. Mansard, "Cat: Constraints as terminations for legged locomotion reinforcement learning," in *Iros*, 2024. Available: <https://arxiv.org/pdf/2403.18765>

[5] Octo Model Team and al., "Octo: An open-source generalist robot policy," in *Proceedings of robotics: Science and systems*, Delft, Netherlands, 2024. Available: <https://octo-models.github.io/>

[6] M. J. Kim *et al.*, "Openvla: An open-source vision-language-action model," *Arxiv preprint arxiv:2406.09246*, 2024, Available: <https://openvla.github.io/>

- [7] Open X-Embodiment Collaboration and al., “Open X-Embodiment: Robotic learning datasets and RT-X models,” in *Icra*, <https://arxiv.org/abs/2310.08864>, 2024.
- [8] F. Jenelten, J. He, F. Farshidian, and M. Hutter, “Dtc: Deep tracking control,” *Science robotics*, vol. 9, no. 86, 2024, Available: <https://doi.org/10.48550/arXiv.2309.15462>