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RA9 - Resilient machines through continuous learning and sensing

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Date (14 March 2024)

Co-funded by the European Union

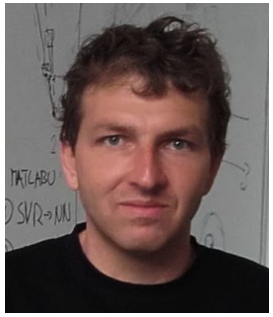
MINISTRY OF EDUCATION, YOUTH AND SPORTS

Robotics and Advanced Industrial Production
CZ.02.01.01/00/22_008/0004590

RA9 - Scope

- end-to-end robot learning with explainability
- versatile resilient robots through whole-body tactile sensing

RA9 - People



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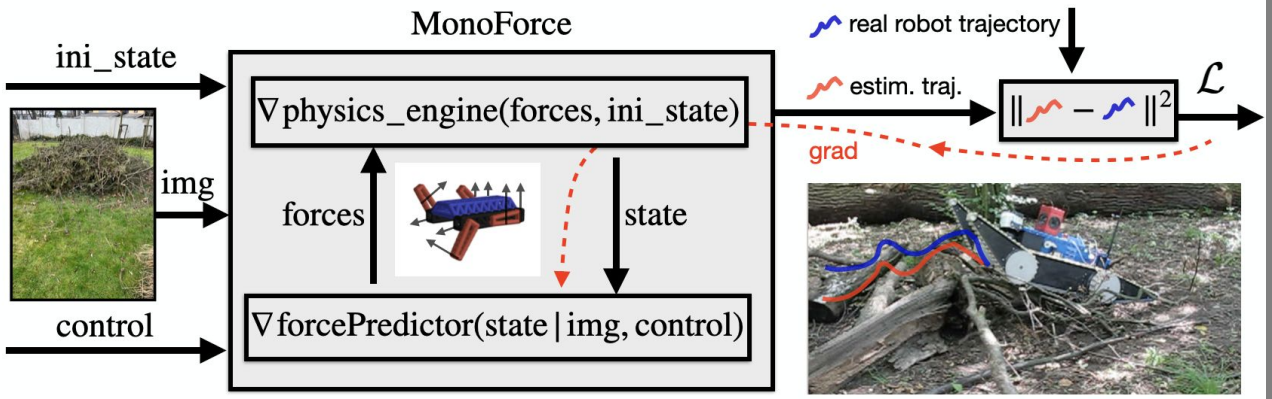
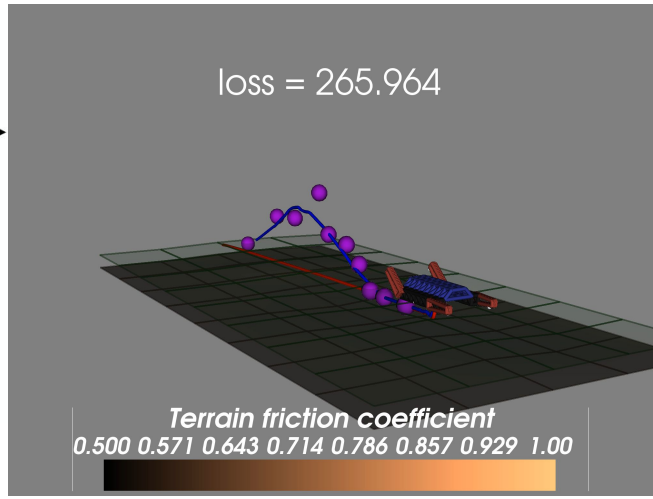
Post-docs and PhD students in hiring process

9.1 End-to-end learning with explainability

- Self-supervised learning of physics-aware grey-box model for predicting robot-terrain interactions
- Source of self-supervision: MonoDepth - color consistency, MonoForce – physics consistency
- Inherent train/test distribution mismatch => good generalization crucial => greybox model
- Self-supervision through planning (RA8)

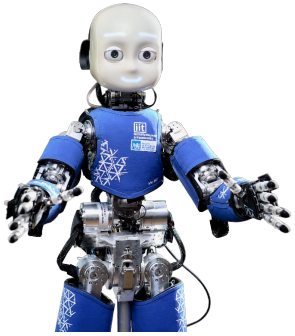




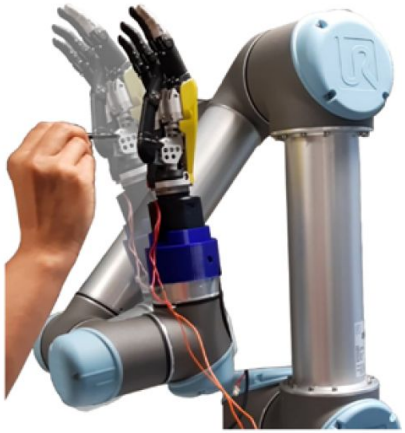
[1] V. Salansky, K. Zimmermann, T.Petricek, T.Svoboda, Pose Consistency KKT-Loss for Weakly Supervised Learning of Robot-Terrain Interaction Model, IEEE Robotics and Automation Letters, 6(3): 5477-5484, 2021. https://sites.google.com/view/kkt-loss

[2] R. Agishev, K. Zimmermann, M. Pecka and T. Svoboda, MonoForce: Self-supervised learning of physics-aware grey-box model for predicting the robot-terrain interaction, IROS 2024 (under review). https://arxiv.org/pdf/2309.09007.pdf

Research objective 9.2 – Versatile resilient robots through distributed reactive control and whole-body tactile sensing

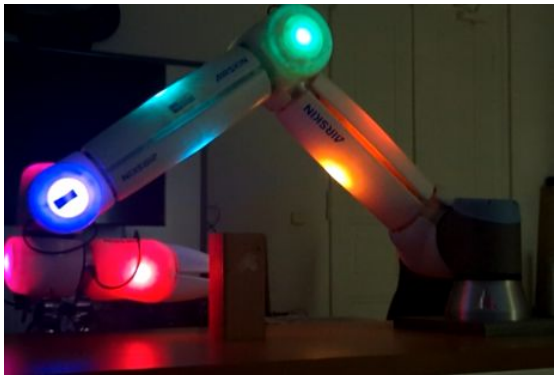


robots with whole-body skin



Liu, F. et al. (2022)

learning to move from contacts - “artificial pain”, withdrawal reflexes



find objects and clean the table with only tactile input (no vision)

collab. with RA7 (Babuška)

resilient bio-inspired robot control – cope with blocked joints, etc.

collab. with RA6 (Přeučil)

month 12

month 30

month 60

Liu, F. et al. (2022) ‘Printed synaptic transistor–based electronic skin for robots to feel and learn’, Science Robotics, 7(67)

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International collaboration

Amphibious robotics

- Whole-body sensing, electric sense (SSSA Pisa, Italy; IDEAS Pol)
- Learning terrain-robot interactions (UOXF, UK; TUDA, Ger)
- Search and Rescue (Rotterdam firefighters, NED)

- Radars, robots in the wild (Uni Orebro, SWE)
- Physics-based learning (Lockheed Martin, US)
- Self-supervised learning (Valeo.ai)

- Physical human-robot interaction, collaborative robotics (TU Munich)
- Neuromorphic vision and touch (IIT Genoa)
- Industrial: Blue Danube Robotics / Airskin (Vienna)

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Thank you for your attention!

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