NRI: INT: Collaborative Research: Buoyancy-assisted Collaborative Robots That are Cheap, Safe, and Never Fall Down.

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Synopsis

- We aim to develop novel buoyancy-assisted robots (BARS) that are intrinsically safe.
- However, we need to overcome the limited payload and the sensitive dynamics.
- Our goal of developing capable BARs requires several improvements, including (1) compact but capable Balloon-based robot hardware, (2) robust sim-to-real techniques, (3) better learning algorithms for diverse behaviors, and (4) careful design of human-robot interaction.

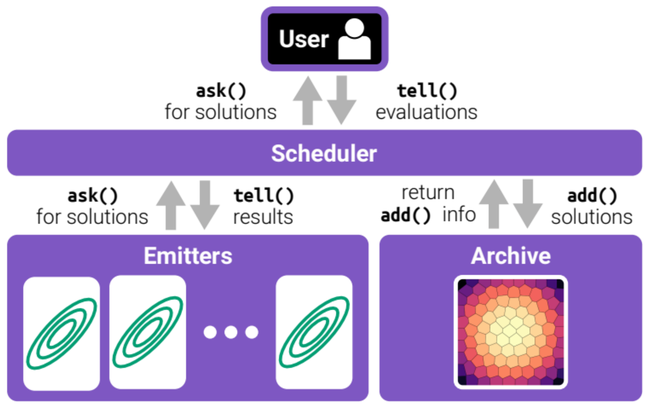
#1. RL-based residual dynamics learning

- We reduce the sim-to-real gap by learning the residual physics of the BALLU robot from the collected real-world trajectories.
- Our Environment Mimic (EnvMimic) leverages deep RL to model the residual dynamics, rather than supervised learning.
- The acquire model leads to 2x better rewards on hardware compared to naïve DR.

Sontakke, N., et al. "Residual physics learning and system identification for sim-to-real transfer of policies on buoyancy assisted legged robots.", under review

#2. Learning diverse behaviors

- We develop quality diversity optimization algorithms that find diverse policies in simulation for different robot morphologies.
- The algorithm can select the best policy to adapt to the environmental changes.
- The proposed algorithm outperforms the state-of-the-art in several benchmark domains.
- We open-sourced the developed package.



Tjanaka, B., et al. "pyribs: A Bare-Bones Python Library for Quality Diversity Optimization.", GECCO'23

Fontaine, M. and Nikolaidis, S. "Covariance Matrix Adaptation MAP-Annealing.", GECCO'23

#3. Human-BALLU interaction

- The safety of BARs makes them suitable for human-robot interaction in crowded scenes, such as building evacuation. We added the LED panel and are working on a user study.

Outreach activity

- We invited 200+ students with diverse backgrounds during the national robotics week and let them interact with the BALLU robot.

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