Proposal for a Master internship

Locomotion in granular media

with Baptiste Darbois Texier (**baptiste.darbois-texier@universite-paris-saclay.fr**).
Laboratoire FAST, Université Paris-Saclay, CNRS 91405 Orsay, France

Many living species evolve in granular environments such as sand. This is the case of snakes that slither throught deserts, sandy lizards that swim below the surface of the sand and razor clams that burrow into the seabed (Fig. 1a) [1]. Moving itself in granular environments is a real challenge, because granular materials are heterogeneous, highly dissipative and have a complex mechanical response. Animals are therefore an incredible source of bioinspiration to find efficient strategies that permit to move in granular environments. This bio-inspired approach could lead to the development of robots capable of performing exploration or rescue missions in deformable granular terrains.

In the FAST laboratory, we are experimentally studying the different strategies used by animals to move around in the sand and testing their effectiveness and robustness. To achieve this, we develop bio-inspired robots and active systems, studying their behavior within a model granular environment. Our primary inspiration comes from the movements of snakes (Fig. 1b), beetles, and moles in sand and soil materials, but we also focus on legged locomotion on granular media (Fig. 1c). The goal of these experiments is to understand the underlying physics governing the interaction between moving objects and granular materials [2–4]. This research will provide a physics-based framework to protect desert fauna and to develop robots capable of navigating sandy environments.

If you are interested in animal locomotion, mechanics of granular materials or robot design and control, please contact us.

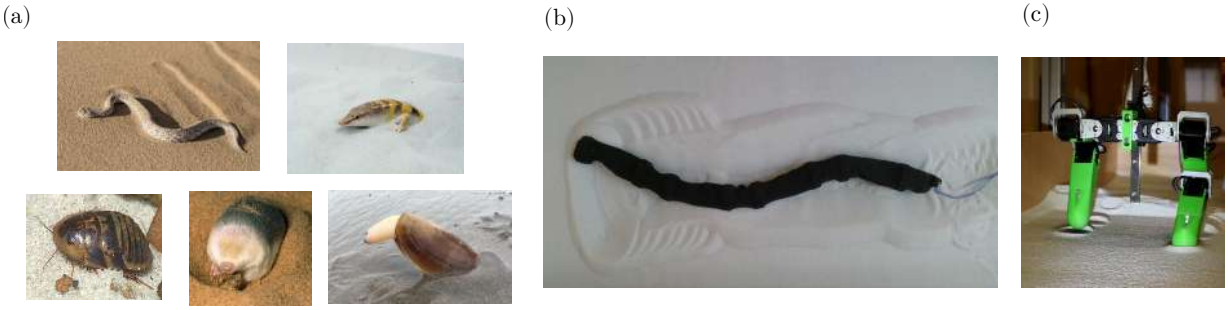

Figure 1: (a) Animals that evolve in granular environements. (b) Snake robot slithering at the surface of a granular material. (c) Legged-robot walking on sand.

References

[1] AE Hosoi and Daniel I Goldman. Beneath our feet: strategies for locomotion in granular media. *Annual review of fluid mechanics*, 47:431–453, 2015.

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[4] René Zuñiga, Carlos Vasconcellos, Baptiste Darbois Texier, and Francisco Melo. Anisotropic frictional model for an object sliding in a granular media. *Physics of Fluids*, 36(1), 2024.