[STATISTICAL PHYSICS AND MODELLING] TOWARDS A CONTROL OF AN ASSEMBLY'S COLLECTIVE RESPONSE: HOW TO CONVERT A DISORDERED ASSEMBLY INTO A SOFT ROBOT?

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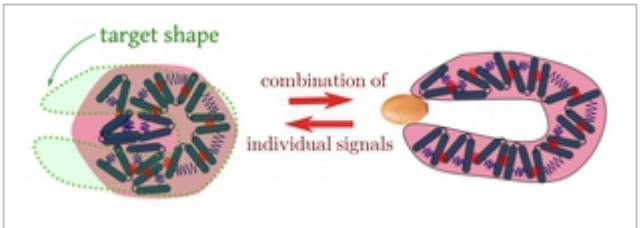
KEYWORD(S) : numerical modelling / soft robotics / disordered systems

SCIENTIFIC CONTEXT :

Compared to their 'hard' counterparts, soft robots [1] display several interesting features, including the ability to squeeze into narrow interstices and to grasp soft objects. However, they are notoriously difficult to design; conventional design strategies target only a limited number of shapes.



How to convert a disordered assembly into a soft robot by selectly activating micro-actuators?

MISSIONS :

The PhD will be dedicated to exploring an entirely original alternative to the design and control of soft robots, whereby one starts with a disordered assembly of constituents and actuates some of these constituents in order to attain a desired shape. In other words, the actuation of some constituents will modify their shape and, since the assembly is dense, this will trigger an elasto-plastic response of the whole system [2]; the goal is to be able to control this global response by proper actuations.

To blaze this new trail, the route will involve
* simulating 2D assemblies of bi-stable particles with a discrete-element method (C++/LAMMPS interface),
* determining the spectrum of possible shapes into which the assembly can morph
* setting up meta-dynamics to guide the system towards a target configuration, by resorting to AI tools (genetic algorithms)

OUTLOOKS :

IMPORTANT: The proposal is not funded yet; candidates should apply fora grant of the Doctoral School

BIBLIOGRAPHY :

[1] KIM, Sangbae, LASCHI, Cecilia, et TRIMMER, Barry. Soft robotics: a bioinspired evolution in robotics. Trends in biotechnology, 2013, vol. 31, no 5, p. 287-294.

[2] NICOLAS, Alexandre, FERRERO, Ezequiel E., MARTENS, Kirsten, et al. Deformation and flow of amorphous solids: Insights from elastoplastic models. Reviews of Modern Physics, 2018, vol. 90, no 4, p. 045006.

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