

BioEngineering Hybrid Robots from nanobots to 3D BioBots

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Abstract:

The combination of biological components and artificial ones emerges into what we called hybrid machines/bots/robots. Here, I will present two types of hybrid systems being developed in our lab which span across different length scales, from a few nanometers to centimeters.

First, I will present hybrid nanobots which combine the best from the two worlds: biology (enzymes) and (nano)technology (nano-particles) providing swimming capabilities, biocompatibility, remote control, multifunctionality and actuation. Besides the understanding of fundamental aspects (1), and controlling the performance of micro-nanobots (2) I will present some of the proof-of-concept applications of biocompatible nanobots such as the efficient transport of drugs into cancer cells (3) and 3D spheroids (4), sensing capabilities (5), antibactericidal applications (6) and the use of molecular imaging techniques like PET-CT (7) or Photoacoustic (8) for the tracking and localization of swarms of nanobots both in vitro and in vivo in confined spaces like mice bladder.

In the second, I will present hybrid 3DBIOBOTS based on the 3D bioprinting of hydrogels and skeletal muscle cells. By electrical stimulation, we studied the adaptability of 3D hybrid Robots after long-term trainings and their force evolution. We bioengineer two systems in our lab: (i) 3D Actuators used as force measurement platform for drug screening (9) and (ii) 3D BIOBOTS that can be a next generation of living soft robotics swimmers (10).

References:

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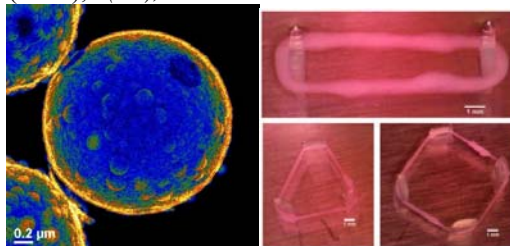


Figure 1. Microbots based on mesoporous silica and urease enzymes (left) and, 3D Bioprinted Soft Robots (right)