Leveraging morphological computation for controlling soft robots

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Traditional robot designs typically employ rigid body parts and high-torque servo motors to obtain simple reproducible models with the goal to facilitate control. On the other hand, soft robotics deliberately expands the design toolbox to a wide range of smart and, often, soft materials. However, using soft bodies comes with a significant disadvantage. Soft materials often have complex and nonlinear dynamics, which makes them hard to model and therefore difficult to control. A promising solution for this is a principle called morphological computation. It's based on observations in nature where we can see how biological systems, which are mostly soft as well, solve this issue: They outsource functionality directly to the body morphology. From this point of view, the seemingly undesired nonlinear dynamics become a powerful resource for implementing nonlinear functionalities, including control. This extends the control design problem to the question of how to design the body morphology of a robot. We will show exsiting examples of how complex morphologies can help to solve control problems and we propose novel ideas on how to embrace nonlinear dyanmics instead of avoiding them. The hope is to inspire members of the control community to develop novel morphological computation based control frameworks for the next generation of soft robots.