

Physically Intelligent Soft Robotics

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Abstract: Different from neuron-based computational intelligence through the brain, physical intelligence leverages structural designs and smart materials to physically encode sensing, actuation, control, adaption, and decision-making into the body of an agent. The stimuli-responsive body materials can enable autonomous sensory, actuation, powering, and other physical intelligence functions. The structural designs of soft body can simplify the required actuation for deformation and motion, as well as enable real-time feedback control-free locomotion and self-adaption.

I will overview our recent work in embodying mechanical intelligence of structural designs and/or materials intelligence of soft active materials in soft robotics, for achieving high performance in manipulation, locomotion, autonomy, and intelligence with reduced control complexity. Examples include adaptive origami and kirigami metabots in noninvasive and delicate grasping and aerial manipulation, snapping instabilities for fast, efficient, and maneuverable soft robotic swimmers under minimal actuation and simplified control, as well as integrating structural designs with soft active materials for achieving autonomy and intelligence in soft robots.

Bio: Dr. Jie Yin is currently a Professor and University Faculty Scholar in the Department of Mechanical and Aerospace Engineering at NC State University. Prior to join NC State, he was an Assistant and Associate Professor at Temple University. Dr. Yin received his Ph.D. in engineering mechanics from Columbia University and M.S. in solid mechanics from Tsinghua University. He is the recipient of several prestigious honors, including the 2025 Presidential Early Career Award for Scientists and Engineers (PECASE) from the White House, the 2022 Cozzarelli Prize from the National Academy of Sciences (NAS), NSF Career Award, and Extreme Mechanics Letters (EML) Young Investigator Award. His group's current research focuses on mechanics guided design of soft robotics, mechanical metamaterials, and shape-morphing functional materials for better health and sustainability.

