M3SoRo - Mobility and Morphing using Modular Soft Robots

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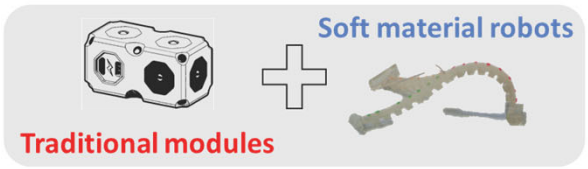


Enhanced Versatility
- Assemble and disassemble
- Highly deformable, can change dimensions
- Can conform to any surface

Improved Robustness
- Repetitive, inter-changeable
- Impact resistant
- Inert to environmental changes

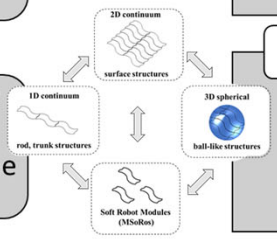
Lower costs
- Costs low due to large scale production
- Single-unit cost low –silicone polymer robot bodies

Research Objectives

Learning mobility (locomotion) principles
- **Discretization** captures factors dominating robot-environment interaction
- Infer '**reduced model**' and mobility principles using dominant interactions

Shape morphing using MSoRos
- **Highly deformable** silicone polymer body
- **Hybrid sensing** using soft and MEMS sensors
- **Electromechanical actuation** motor-tendon, SMAs
- **Friction manipulation** as soft materials can flow

Environment adaptive morphing
- **Metamorphosis** between rolling-ball (3D), sheet (2D) or snake-like rod (1D)
- **Environment awareness** by fusing reduced model and robot model information



Challenges

- *Hardware.* module dexterity, power management and inter-modular docking
- *Control.* 'Environment-centric' using motion primitives vs 'model-centric'
- *Morphing.* Dimensional morphing and environment aware morphing
- *Application-specific.* complex, adverse (heat-cold) environments, economic cost

Scientific Impact

- *Mobility principles for complex environments*. Reduced order models (ROMs) learn factors that dominate robot-environment interaction
- *Open-source untethered MSoRos.* These will enhance versatility, robustness and cost-effectiveness of traditional robots
- *Environment awareness and reconfiguration*. Task specific morphing of collective MSoRos

Technology Impact

Promising solution where terrain is unknown and unstructured.

MSoRos swarms have potential applications to the fields of disaster relief (search & rescue operations), space exploration and precision agriculture.

Education Impact

Soft robots easy to disseminate as safe to operate. Encourage students toward STEM, robotics.

Excite young minds. Connect illustrations of Transformers, Big Hero 6 with real-life morphing soft robots.

Research Impact

Understanding locomotion in unknown, unstructured environments.

Hybrid control models. 'Environment-centric' exploratory learning with 'model-centric' knowledge.

agile robotics lab

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