

Soft Robotics to the Rescue: Intuitive Wearable Interfaces and Assistive Robots for Fire Protection

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Objectives/Value Proposition

- Enabling robots to perform inspection in uncertain, rapidly evolving, and potentially dangerous environments
- Soft robots that can navigate in extreme uncertainty and clutter
- Teleoperation to 'beam' high-level decision making skills of experienced users into such environments through a wearable haptic interface
- A range of embedded sensors to map the environment and provide real-time situational awareness

Motivation



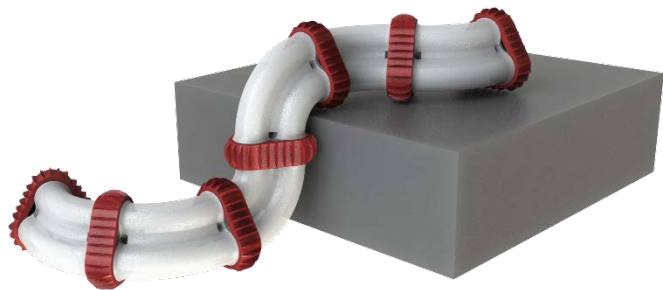
Current search and rescue operations are performed by humans, with difficulty reaching survivors and potential safety concerns

Current robots are large and expensive, with limited mobility and intelligence under uncertainty

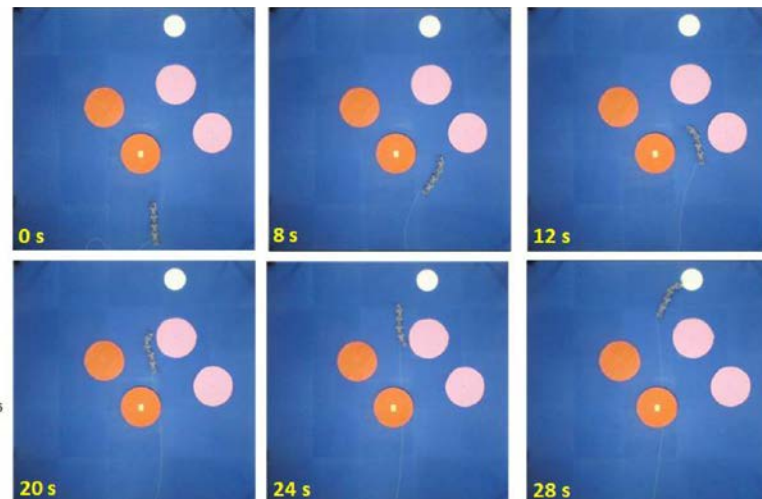
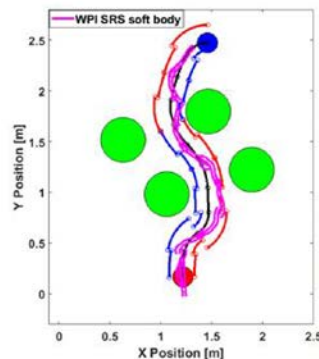


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Soft Robotic Snakes

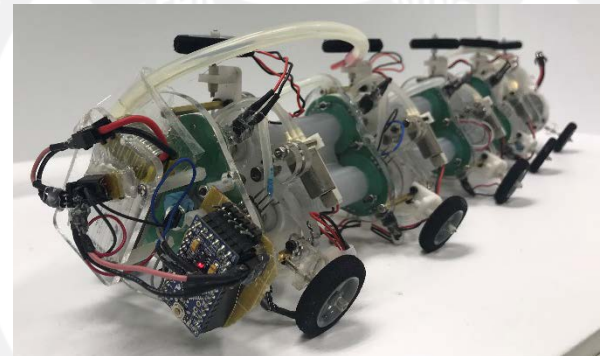
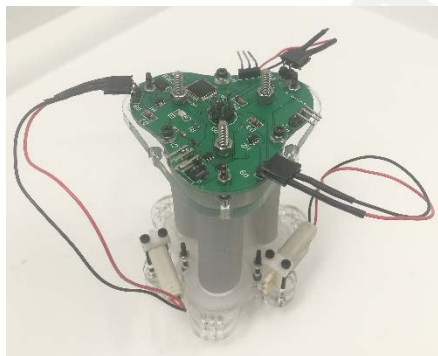


A soft robotic snake-like mobility platform that can go through holes and cluttered environments without getting stuck



Soft Robotic Snake

Soft Robotics Laboratory
WPI
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Wearable Haptic Interfaces



- An intuitive wearable user interface that detects user's finger and arm motions and provides safe kinesthetic haptic feedback
- Teleoperate the motion of the snake and receive haptic feedback that corresponds to sensor readings



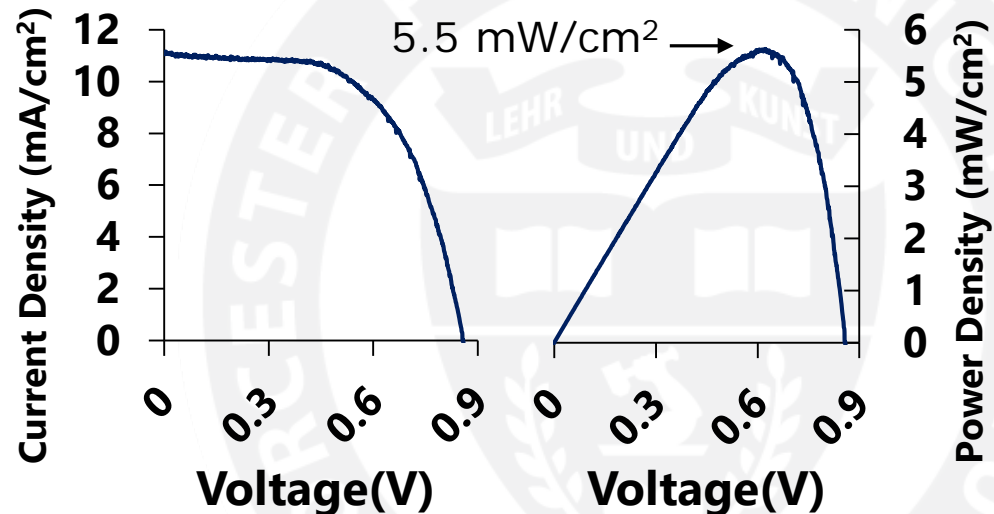
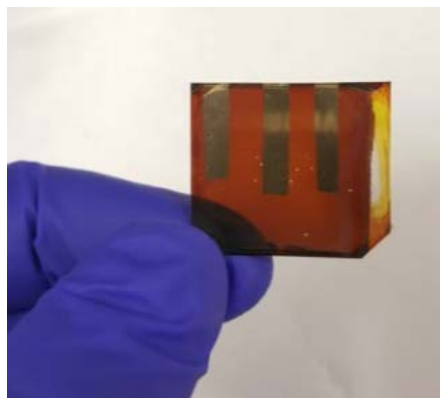
Flexible thin-film devices on soft robots for fire safety

Lightweight, flexible, ultrathin:

- thermal detectors and chemical sensors with low power consumption
- thermo-photovoltaics (harnessing IR emissions for power)

Low-cost functional robots via seamless integration of sensor and power components fabrication into robot fabrication

Lightweight, Flexible Ultrathin Photovoltaic Devices



Seed Grant Activities

- Developing **soft wearable haptic gloves** that will measure the hand and arm motions of the user and the physiological state of the user;
- Developing a **fully sensorized soft robotic snake** that can be commanded by the user to make local measurements of conditions of interest and communicate them back to the user;
- Developing a **bilateral teleoperation control** architecture using sensory substitution where high temperature, low visibility, or high toxic gas concentration areas may be converted to physical haptic forces that the user may feel as a direct form of feedback;
- **Evaluating the developed systems and algorithms** in a realistic thermal/smoke environment and establishing relevant measurements related to domain specific problems including fire, toxic gas release, and explosive mixtures.