DESIGNING AN UNDERWATER EEL-LIKE ROBOT AND DEVELOPING ANGUILLIFORM LOCOMOTION CONTROL

Presented by

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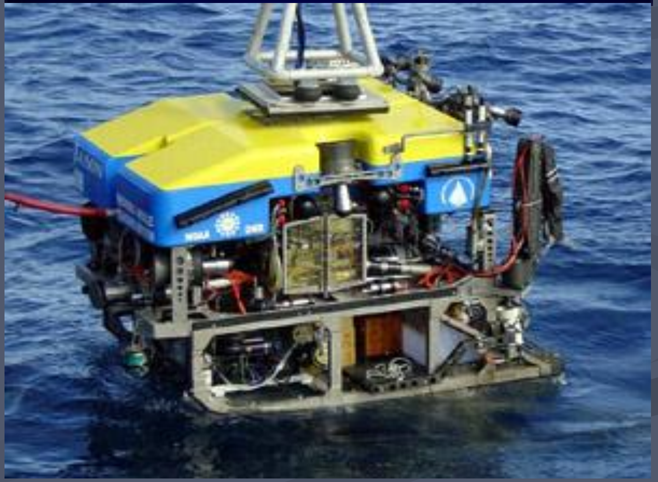
Underwater Robotics

Robots underwater!

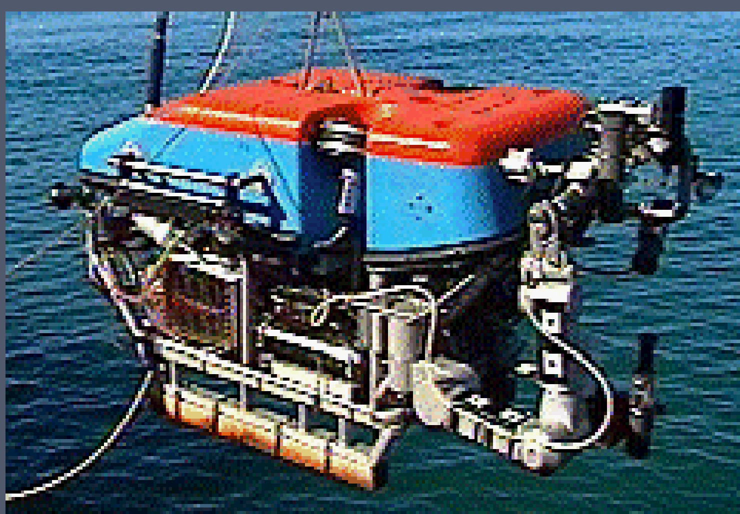
But why?

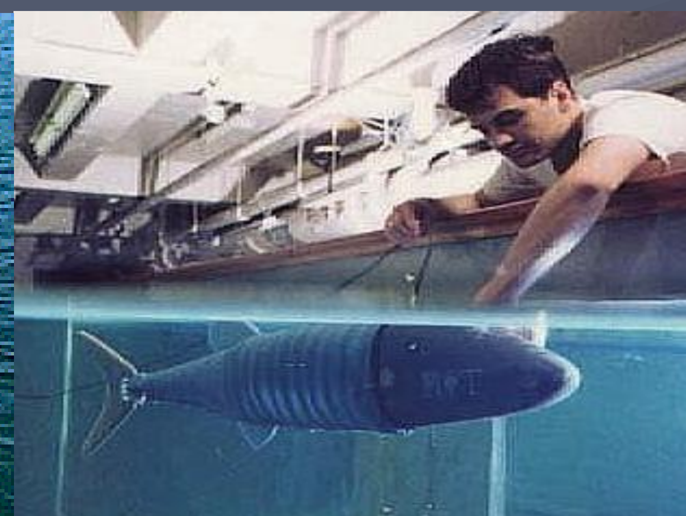
- The ocean is highly unexplored
- Oceanographic Institutes
- Alvin/Jason II



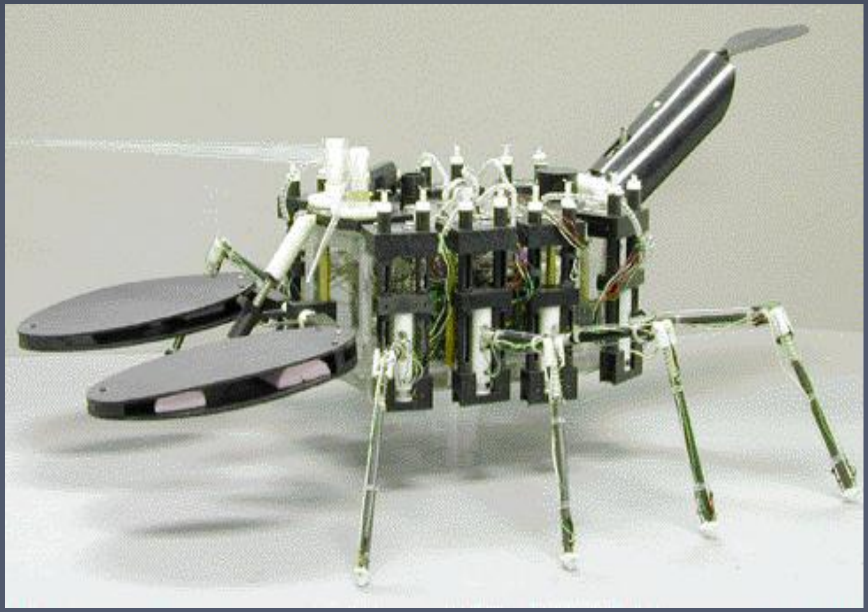
Undersea Exploration

Goal: Untethered Mobile Robots Increase Efficiency, Agility and Maneuverability





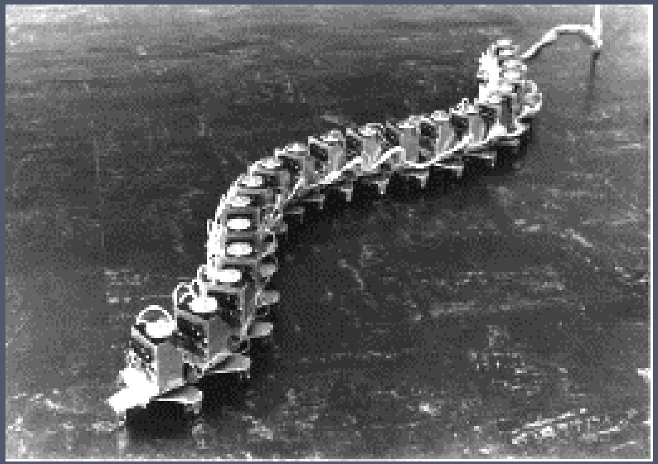
Legged biomimetic robots



- Northeastern University's Ambulatory Underwater Robot
- IS Robotics Ariel Robot

Mobile Robots for Inaccessible Environments

- Legless and Wheel-less
- Locomotion by Undulating Waves of the Body That Exploit Forces of Resistance in the Environment



Why an Eel-Like Robot?

The Challenge of Applying Robotic Technology to New Environments

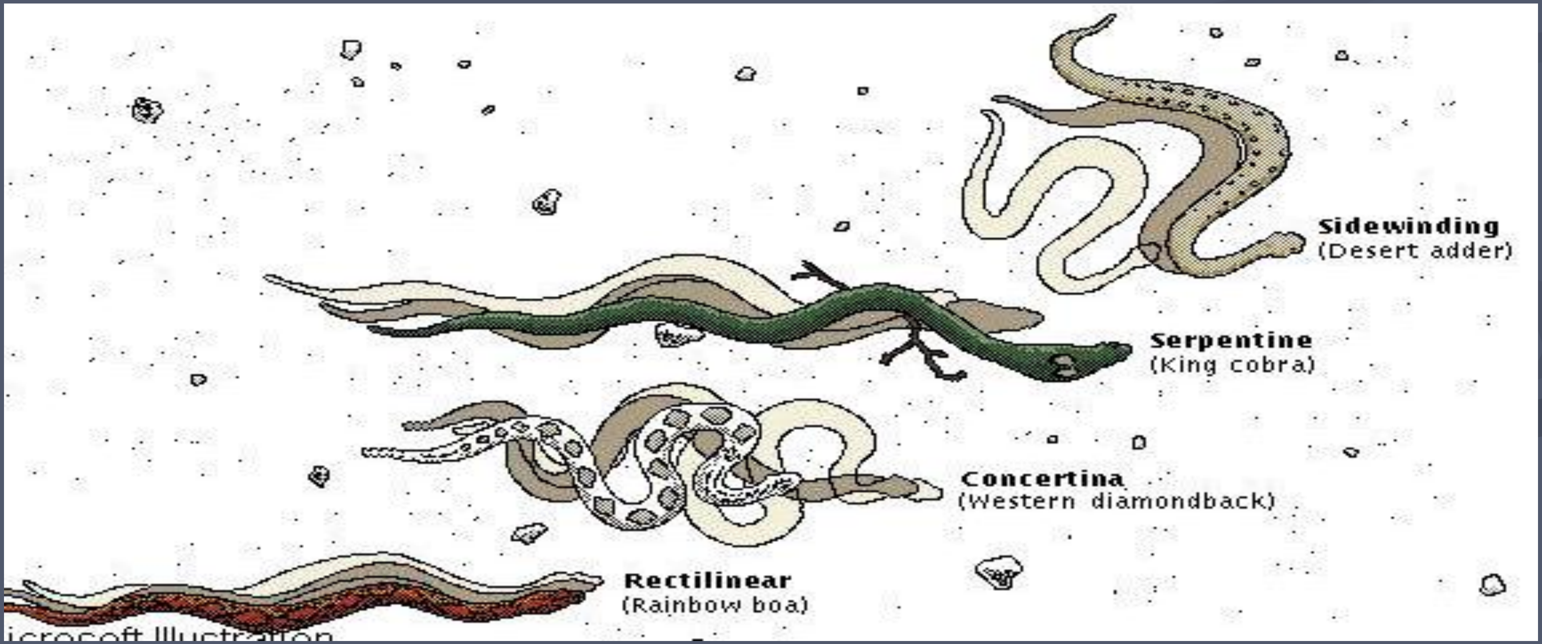
- Underwater Exploration and Surveillance
- Medical Instruments (Endoscopes)
- Manipulators in Confined Spaces
- Mobile Robots in Hazardous Areas

The Eel-Like Robot:

- Underwater, Un-tethered Mobile Robot
- Biomimetic-modeled after the eel and snake
- Hyper-Redundant-composed of a series of repeated links

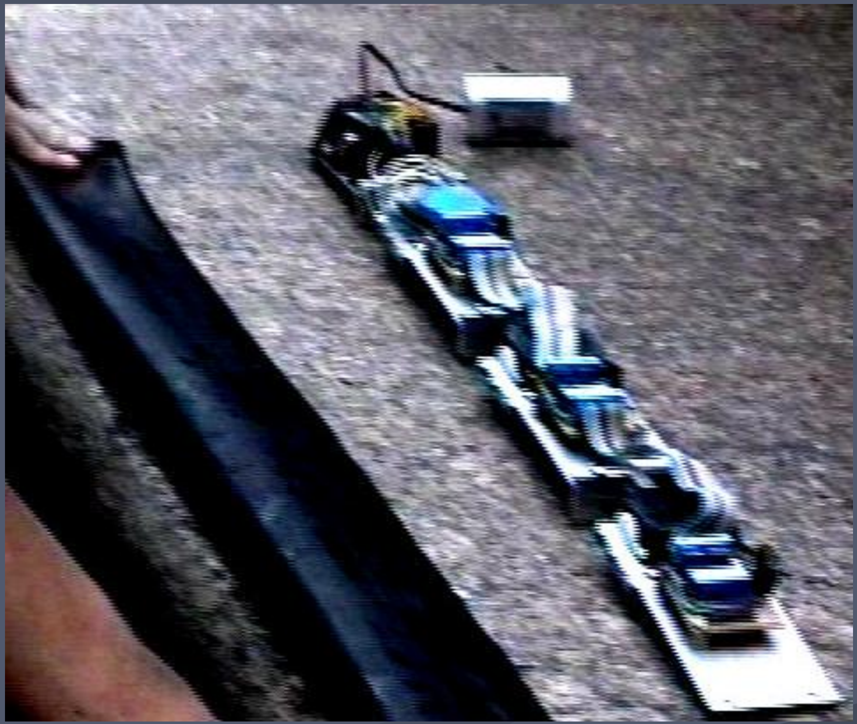
Biological models of locomotion

- Rectilinear motion
- Serpentine motion
- Concertina motion
- Side winding motion



The Mechanical Changes

- Created Shells to Mimic Body Shape of Eel
- Created Belly Scales to Mimic Snake
- Developed Waterproofing Method

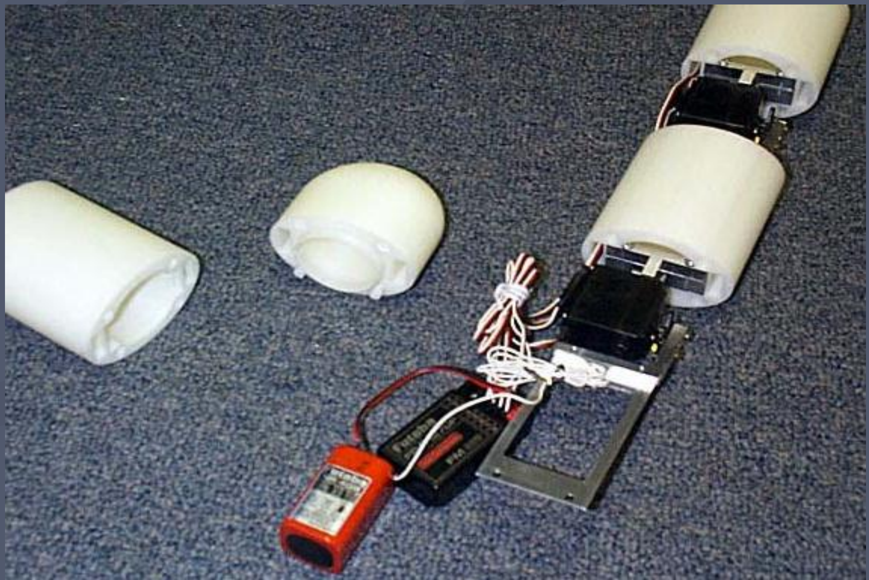


Electrical Changes

- Due to increased number of motors (joint actuators), change from Basic Stamp II mediator, to PIC controller

- Use Futaba S9303 Servomotors (Water-Resistant)

- Use Waterproof AC Adaptor



Waterproofing the Hardware

- **Model Generation -1**

  -rubber tube covering

- **Model Generation -2**

  -blue plastic coating and putty

- **Model Generation -3**

  -epoxy resins and dielectric grease to waterproof

Further Work

- Model has improved modularity (parts are accessible and replaceable) and functionality (better mimics biological models)
- Need to develop better buoyancy
- Need to develop closed loop control using video feedback of position and orientation

Suggestions for performance

- improve with more homogeneous weight distribution along the length of the body
- machining out the center area of the aluminum plates within each link could easily reduce the total mass of the eel
- The eel structure using alluminium plates should be symmetrical

Conclusions & Recommendations

- similarity of application of robot on land or in water
- Can move in sinusoidal gaits as in water
- move in a curve rather than a relatively straight path
- have neutral buoyancy and the electrical hardware has been shown to be waterproof
- The battery (power source) is readily accessible for recharging or replacement

References

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- M.S. Triantafyllou and G.S. Triantafyllou. An Efficient Swimming Machine. Scientific *American*, pp. 64-70, March 1995

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