COMPUTATIONAL VISION AND ROBOTICS LABORATORY

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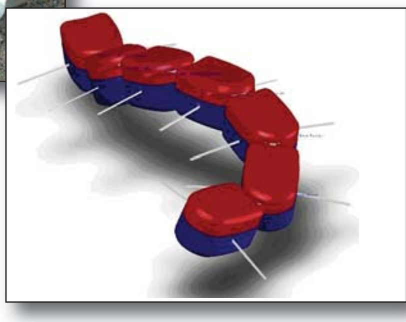
NEREIS: Bio-inspired Pedundulatory Robotic Locomotion



Robotics in unstructured environments: Locomotion and motion control are among the most significant challenges for robotic applications dealing with unstructured and tortuous environments. Such applications range from inspection of cluttered industrial environments, to novel diagnostic systems for healthcare (e.g., endoscopic access to the human body), to robotic tools for search-and-rescue operations, and to robotic assistants for planetary exploration. The human gastrointestinal tract, a building damaged by earthquakes or the Martian surface, all are environments quite different from the usual indoors environments, where most present-day mobile robots operate.

Biological inspiration: The morphology of our robots is inspired by the polychaete annelid marine worms, which live in environments where mobility is a significant challenge, swimming in the depths of the oceans, burrowing in the mud and sediment of the sea bottom, or crawling on the sand of the seashore.

The NEREIS pedundulatory robots: The locomotion of the NEREIS robots is characterized by the combination of a unique form of tail-to-head body undulations (different than snakes or eels), with the rowing-like action of numerous active lateral appendages (called parapodia), distributed along their segmented body. This type of robot locomotion is being studied theoretically, computationally and experimentally, for the first time, by our group at FORTH-ICS, and was named *pedundulatory* locomotion. The NEREIS robots implement successfully a rich repertoire of pedundulatory gaits on sand, gravel, mud, grass, and several other unstructured substrates.

More details, as well as related papers and videos, about NEREIS and SIMUUN, can be found at the web site http://www.ics.forth.gr/~tsakiris

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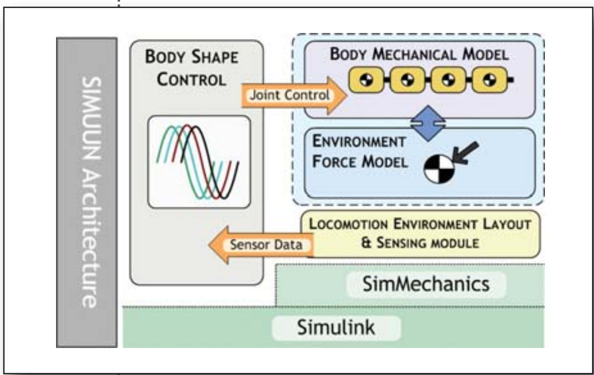
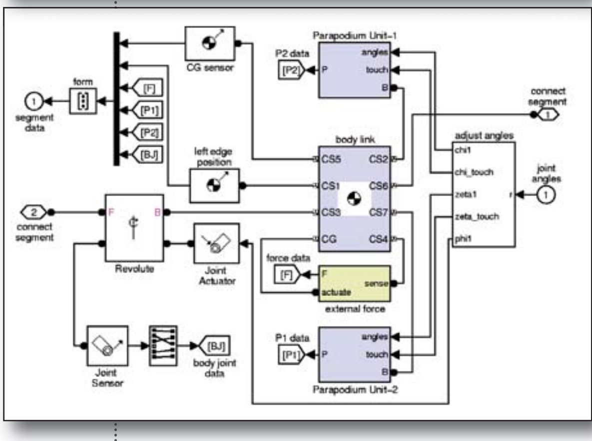
The SIMUUN simulation environment: Computational tools aiming to assist robotic and biological research on various aspects of undulatory and pedundulatory locomotion, are being developed at ICS-FORTH. Based on the Matlab/Simulink™ software suite, the SIMUUN simulation environment is characterized by a modular, block-based architecture, as well as by simple and intuitive drag-and-drop operations to develop computational models of undulatory locomotors. It contains software libraries for their mechanical, control and sensing components, including components modeling interaction forces between the robots and various locomotion environments, and several neuromuscular control models. SIMUUN can greatly facilitate the design and modeling of such robotic systems, as well as the analysis of biological data from organisms propelling themselves by undulations (e.g., snakes, eels, worms, spermatozoa).





COMPUTATIONAL VISION AND ROBOTICS LABORATORY (CVRL)

The Computational Vision and Robotics Laboratory (CVRL) of FORTH-ICS was established in 1985. The research and development efforts at CVRL focus on the areas of computational vision and autonomous mobile robots that perceive their environment and exhibit intelligent behaviours.

Research in this field has theoretical interest because it leads to the computational and mathematical modelling of perception and action, and contributes to a better understanding of the mechanisms involved in the corresponding capabilities of biological organisms. Furthermore, this research is of practical interest because it forms the basis for the development of interesting and often significant robotic systems, such as robotic wheelchairs for people with disability, tour-guide robots in museums and other exhibitions, robots performing routine tasks such as cleaning and surveillance. Moreover, by-products of this research prove extremely useful in other application areas that are not directly related to robotics, such as virtual and augmented reality, 3D modelling and environmental monitoring, event detection, and content-based image retrieval. Efforts at CVRL are balanced between basic and applied research, resulting in the construction of robust vision and robotic systems for various application domains.

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