BREAKING THE SURFACE 2016 – List of demonstrations

DEMONSTRATIONS:

- OceanScan (PT)
- Brodarski Institute (HR)
- CADDY FP7 project
- NATO SpS MORUS project
- Multimodal Aquatic Micro Air Vehicle AquaMAV
- Illmenau Medusa - Surface-aided AUV path following: theory and practice. Demo with a Medusa-class vehicle

Brodarski Institute

Brodarski Institute is an institute of applied technical sciences in the fields of maritime and green technologies. As a research and development and technology organization it has 65 years of experience. Range of activities from experimental development of products to prototype making, turn-key projects, computations, supervisions, tests and measurements are among the main Institute's activities. Brodarski Institute dominantly supports domestic industry, but it is also recognized by foreign partners as a reliable partner in development projects and technology transfer.

The Institute as a limited liability company generates its revenue through commercial contracts with the clients. About 40% of the Institute's revenue is generated from foreign markets. A high competitive capability of Brodarski Institute is ensured by its experts and scientists in the fields of shipbuilding, marine engineering, green technologies and environmental protection, mechanical engineering, electrical engineering, chemical engineering, physics, metallurgy, industrial design and other specialized fields.

The highly professional staff and a number of well-equipped laboratories with measurement and other specialized equipment have enabled the Institute to become a regional scientific and expert centre in the fields of maritime and green technologies. In the scientific and higher education system of Croatia, Brodarski Institute represents a steady support in creation and training of professionals whose excellence guarantees reliable partnership for economic development.

FP7 CADDY project - Divers operate in harsh and poorly monitored environments in which the slightest unexpected disturbance, technical malfunction, or lack of attention can have catastrophic consequences. Key maneuver in complex 3D environments, carry cumbersome equipment, while performing their mission. To overcome these problems, CADDY aims to establish an innovative set-up between a diver and companion autonomous robots (underwater and surface) that exhibit cognitive behaviour through learning, interpreting, and adapting to the diver's behaviour, physical state, and actions.

The CADDY project replaces a human buddy diver with an autonomous underwater vehicle and adds a new autonomous surface vehicle to improve monitoring, assistance, and safety of the diver's mission. The resulting system plays a threefold role similar to those that a human buddy diver should have:

1. the buddy "observer" that continuously monitors the diver;
2. the buddy "slave" that is the diver's "extended hand" during underwater operations performing tasks such as "do a mosaic of that area", "take a photo of that" or "illuminate that"; and
3. the buddy "guide" that leads the diver through the underwater environment.

The envisioned threefold functionality will be realized through S&T objectives which are to be achieved within three core research themes:

• the “Seeing the Diver” research theme focuses on 3D reconstruction of the diver model (pose estimation and recognition of hand gestures) through remote and local sensing technologies, thus enabling behaviour interpretation;

• the “Understanding the Diver” theme focuses on adaptive interpretation of the model and physiological measurements of the diver in order to determine the state of the diver; while

• the “Diver-Robot Cooperation and Control” theme is the link that enables diver interaction with underwater vehicles with rich sensory-motor skills, focusing on cooperative control and optimal formation keeping with the diver as an integral part of the formation.

NATO SpS MORUS - the main goal of MORUS project is a design and development of a fully operational complex robotic system prototype comprised of an Unmanned Aerial Vehicle (UAV) and Unmanned Underwater Vehicle (UUV) capable of autonomous and cooperative mission executions related to environmental, border and port security.

The proposed research is in internationally competitive field with the main objective to design and develop autonomous aerial and marine robotic system, capable of collective engagement in missions taking place in dynamic and nondeterministic environments.

The design will focus mainly on payload enhancement and UAV autonomy which is mandatory for UUV transport. Besides that, a docking system and cooperative control algorithms will be developed enabling autonomous deployment, re-deployment and data exchange at the open sea. Operating environment of the proposed prototype is an unknown, uncertain and remote, i.e. far from a human operator. Therefore, a whole set of novel cooperative control algorithms, combined with augmented human machine interface, will be designed and implemented in order to ensure safety and recoverability of the described system.

Multimodal Aquatic Micro Air Vehicle AquaMAV - Locomotion in unstructured terrain is one of the most significant challenges to robots operating in an outdoor environment. Whilst many amphibious robots exist, these robots are not able to cross large, sheer obstacles, and can only exit the water on a gentle incline. We are aiming towards the development of an Aquatic Micro Aerial Vehicle (AquaMAV), a fixed wing vehicle designed to fly to a target, dive into the water and subsequently execute an impulsive leap om the water surface, transitioning back to flight. This robot will find use in disaster relief, and oceanography, particularly in areas such as flooded collapsed buildings, or rocky, littoral ecosystems, where obstacles impede the free movement of conventional aquatic vehicles and prevent close observation by purely aerial robots.

Illmenau Medusa - Surface-aided AUV path following: theory and practice. Demo with a Medusa-class vehicle

The operation of autonomous underwater vehicles is still a big challenge, especially for universities which might not have access to Doppler Velocity Logs or high-class Inertial Navigation Systems. In our demo, we show the operation of a submerged marine robot which receives position data via a towed buoy equipped with a GPS antenna. The buoy was newly designed to feature the GPS antenna additionally to a WiFi antenna for supervision and safety features. The employed robot system is a MedusaD, developed and made available for our university by the Instituto Superior Técnico, Lisbon, Portugal, under a special agreement.