Bono Serena

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Field Robotics with Daniele Rus, Roland Siegwart, Stefan B. Williams moderated by Gregory Dudek

The moderator gives a quick overlook of what field robotics is and why, according to him, it is the most important branch of robotics. Field robotics is the branch of robotics dealing with the outdoor and the unstructured world. It divides in terrestrial, in and under the water and in the air. The reason why he reckons it to be the most important field in robotics is that the world is still mostly outdoor. Despite the crucial importance of its issues, it still contains many challenges unsolved. Some of which are: the mobility, due to the exogenous forces, flexible structures and non-uniform friction and the perception, lack of strong priors on what is out.

The first panelist is Roland Siegwart, professor of Autonomous Systems at ETH and founder and CO-director of Wyss Zurich. According to him, field robotics mostly deals with dynamic environments, in those highly unstructured scenarios, theoretical work is not enough. He illustrates some of the main works in terrestrial field robotics: one example is Vertigo, a car-like robot, that can go on ceiling thanks to its propellers. This robot allows to go to places where it was not possible to go with wheels. Another example is Ascento, a robot with wheels and legs, it can jump, go on sidewalks and has much more flexibility in the daily environment. The continues presenting some achievements in airfield robotics: Wingtra robot is mainly concerned with carrying and get off the ground objects. It is equipped with a minimalistic and highly optimized system: only 4 degrees of freedom and two propellers, enable the robot to work with great amount of wind. The second example regards flying on Mars, the hostile condition of the atmosphere makes impossible to land on the surface once taken off, Atlantic Olar robot can keep flying 81 hours nonstop. Next generation of flying robots can replace people hanging on ropes in highly dangerous conditions. One of the main challenges of field robotics is combine rigor and relevance: the academic world tends to solve virtual problems: take on a problem, simplify it as to make it nicely solvable, but no more related to the real world. According to the speaker, it is dangerous to apply black box learning or end to end learning as Machine Learning will most likely not substitute the model but enhance it.

The second panelist is Daniele Rus, director of the Computer Science and Artificial Intelligence Laboratory (CSAIL) at MIT. She begins by answering Siegwart on the relevance of the model. She thinks that the model keeps us limited on physics and mathematics domain, which can model quite accurately the movement. Using models as priors for reason and decision making is though much harder and requires more symbolic higher order abstraction. Then she starts presenting the autonomous car developed at MIT. For that task they intelligently coupled machine learning approach to learn from drivers with model predictive control for execution. Combining machine learning with model base controller, enabled the robot to work in never seen environments. The simulation engine was able to have the robot failing many times in simulation. To deal with covid-19 they exploited navigation and coverage support developed in contest of other applications, to create a UV disinfecting robot operating indoor. The robot is disinfecting the air of 4000 ft^2 surface, in about half an hour. Another experiment regarded the ventilators shortage: they tried to create ventilators from affordable easily accessible parts. Their robots' mechanical arms automatically pump air inside a tube, replacing the ventilator. Addressing climate change they developed SoFI, a soft robotic fish able to record oceanic flora and fauna without disturbing it. One major issue in taking pictures inside water is color distortion: water absorbs color wavelengths. Adaptive illumination enables robot fish, to capture images in true colors by measuring the distance to the object, compute the absorbed light and thorough a multicolor illumination device, control the synthesis of the inverse process.

The final panelist is Stephen B. Williams, professor of Marine Robotics at the University of Sydney. He presents the main projects of Sydney University Robotic field center. Focus of this association's research has been platform sensing, navigation, and mapping, planning and control, data analytics and applications. Marine Science was designed as one of the 8 priority of the NCRIS program (National Collaborative Research Infrastructure Strategy). Some of the observed changes in the marine ecosystem are coral bleaching and increase in cyclones' activity. The effects of climate-driven ocean change are diverse: manage the large and growing repository of online image data requires more efficient tools, identifying patterns in the data can help guide analysis toward organisms of interest: broad scale mapping of the environment, learning relationship between structure and images guides to probabilistic prediction to where to find species. One of the examples the researcher worked on is the automated classifier for lobsters. One of the main challenges in the work of researchers is to align the number of deployments to the number of recoveries. It is not always that easy to recover tools from the ocean depths, and in the future one of the objectives is to develop dexterous manipulation capabilities in underwater environments.