Artificial Intelligence for Distributed, Communication Constrained Undersea Sensing and Monitoring

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Abstract

Undersea sensing and monitoring is currently transitioning toward distributed sensing concepts using networks of autonomous underwater vehicles. Dependent on acoustic communication with a channel capacity many orders of magnitude smaller than the air and land-based equivalents, the operation of such new distributed undersea observation systems require a much higher level of autonomous, distributed data processing and control than land- and air-based equivalents. Nested Autonomy is a new command and control paradigm, inherently suited for the layered communication infrastructure provided by the low-bandwidth underwater acoustic communication and the intermittent RF connectivity. Implemented using the open-source MOOS-IvP behavior-based, autonomous command and control architecture, it provides the fully integrated sensing, modeling and control that allows each platform to autonomously detect, classify, localize and track episodic events in the ocean, without depending on any operator command and control The prosecution of an event, such as the detection and tracking of episodic oceanographic events such as fronts or internal waves, may be initiated by the operators using very simple high-level acoustic commands. The event information collected by each node in the network is similarly reported acoustically back to the operators as compact event reports, using a dedicated command and control language, Goby DCCL. Collaborative processing and control is exploited when the communication channel allows, e.g. for collaborative tracking of a coastal front, or the tracking of marine mammals. Examples will be given from several recent field deployments involving autonomous underwater and surface vehicles for oceanographic and acoustic undersea sensing and monitoring.