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**Path Finding for Maximum Value of Information in Multi-modal Underwater Wireless Sensor Networks**

**Abstract:**

We consider underwater multi-modal wireless sensor networks (UWSNs) suitable for applications on submarine surveillance and monitoring, where nodes offload data to a mobile autonomous underwater vehicle (AUV) via optical technology, and coordinate using acoustic communication. Sensed data are associated with a value, decaying in time. In this scenario, we address the problem of finding the path of the AUV so that the *Value of Information* (VoI) of the data delivered to a sink on the surface is maximized. We define a *Greedy and Adaptive AUV Path-finding* (GAAP) heuristic that drives the AUV to collect data from nodes depending on the VoI of their data. For benchmarking the performance of AUV path-finding heuristics, we define an integer linear programming (ILP) formulation that accurately models the considered scenario, deriving a path that drives the AUV to collect and deliver data with the maximum VoI. In our experiments GAAP consistently delivers more than 80% of the theoretical maximum VoI determined by the ILP model. We also compare the performance of GAAP with that of other strategies for driving the AUV among sensing nodes, namely, random paths, TSP-based paths and a “lawn mower”-like strategy. Our results show that GAAP always outperforms every other heuristic in terms of delivered VoI, also obtaining higher energy efficiency.

**Existing System:**

In such a scenario, the AUV could be made aware of a node sensing relevant events through acoustic communication, so that it can travel to that node to collect sensed data and then surface to transfer them to the network data collection center. This operation should be done swiftly, so that it does not affect the value of the data as perceived by the user, in that such value typically decays in time . Typical examples include realtime video from monitoring valuable assets, such as cultural heritage relics, CO2-filled boreholes, oil wells, etc. The value of a chunk of data can be defined intuitively through the benefits obtained by taking an action based on it. For instance, if an oil spill is reported, the owner of the oil rig can timely intervene and save the costs of further damage and environmental cleanup. Thus, the value of this notification is proportional to the money saved through the timely intervention. Naturally, the earlier one can intervene, the better. This is why, in most situations, the VoI is largest at the very moment an event is sensed and then it decreases in time. Different events will have different initial VoI, and their value may decrease differently as a function of their urgency. For example, information on oil spills is urgent and its value decreases over time spans of few tens of minutes. On the other hand, the value of information about signs of corrosion of underwater pipes decreases at a slower pace.

**Proposed System:**

We define a new Integer Linear Programming (ILP) model for finding AUV paths that maximize the VoI of data delivered to the sink. Our model provides provable bounds on the best possible network performance (e.g., the best achievable VoI) for benchmarking distributed protocols. The model is independent of sensor deployment strategies, and has parameters for controlling data generation rate, data transmission rates, and AUV speeds. Our solution allows us to compute an upper bound on the maximum VoI retrievable from networks whose size is comparable to that of actual (4 to 9 nodes) and desirable (12 to 35 nodes) UWSNs. To the best of our knowledge this is the first model for finding AUV path that takes into account the VoI.

We define a realistically deployable heuristic for AUV path finding that adapts to events occurring at unpredictable locations and times. The AUV chooses the next node to be visited based on the VoI it expects to collect at the next location. The information needed to make this decision is propagated to the AUV using short *event packets* transmitted acoustically. The AUV plans to visit a node that has sent an event packet if and only if visiting that node increases the VoI of the data it will deliver to the sink. Because it makes decisions based on what is best at the moment, and adapts the path finding process to new information, we call our heuristic *Greedy and Adaptive AUV Path* finding, or GAAP for short.