

C-IoT Pump Priming Proposal

LoRa Communication for Sparse Robot Swarms

Kath

1 Activity

Sparse Robot Swarms, are a concept conceived by Danesh Tarapore and myself that will bridge the gap between swarm robot research in simulation and tabletop implementations on the one side, and practical applications scenarios on the other. Sparse swarms give up physical proximity among the robots; instead robots will be typically separated by over a thousand times their body length, but nevertheless coordinate their motions and actions.

The aim of the here proposed activity is to map the RF environment and link-quality for of-the-shelf LoRa modules mounted on small all-terrain rovers. LoRa is largely used in static environments and with antennas well above ground. Little is known about its suitability for small ground rovers that could be applied in environmental or agricultural monitoring tasks. From field tests under static conditions, performed as part of a recent Part III project (David Jones, 2019, Figs. below) we know that a sufficient data rate can be achieved at 1/2 km range within dry forests even when TX and RX stations/antennas are at ground level.

This request is for consumables to be bought now and to be used in two upcoming Part III projects (Sam McCreery, Ben Cserkuti) to map the LoRa peer-to-peer channel capacity under a range of configurations (physical layer, protocol) and conditions (terrain, weather) while the radios are in motion and exposed to the electromagnetic noise on small rovers.

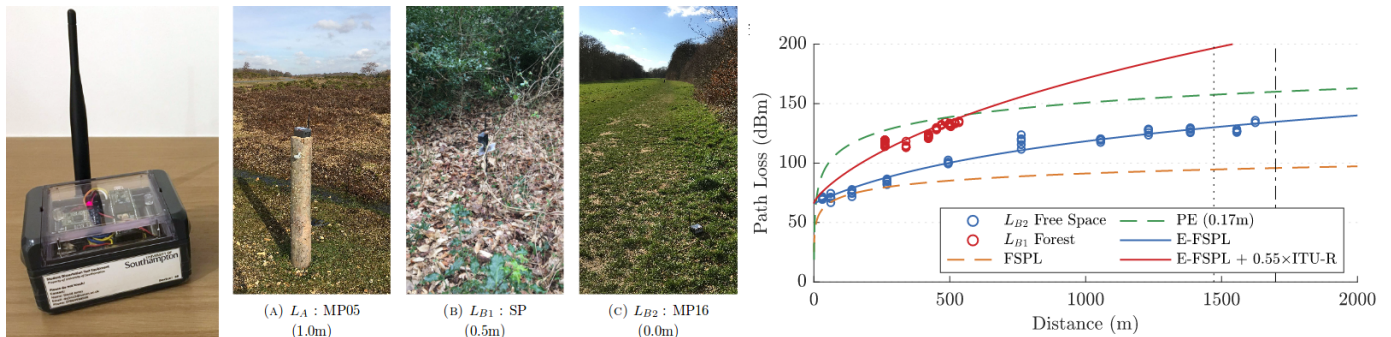
The strategic fit to the C-IoT lies firstly the development of a distinctive capability in the IoT area with mobile sensor platforms that can in the future link up with other C-IoT activities (e.g. with Nick Harris' salinity sensors) to enable applications in environmental monitoring and precision agriculture. Secondly, in bridging from IoT activities to nascent robotics activities in ECS, and thirdly, in getting undergraduate students involved in IoT research and familiarized with the technologies.

2 Outputs

The ability to communicate over large distances without infrastructure, is key to the Sparse Swarm concept. Preliminary results that *demonstrate the feasibility of the rover to rover communication in the targeted forest environment* would significantly strengthen our attempts to win funding for the development of the Sparse Swarm concept. Results from the here proposed activity are not expected before the end of the year, but will be available no later than in the second quarter of 2020. A draft proposal to EPSRC for Sparse Swarms has been developed by Danesh and myself jointly with Roderich Gross in Sheffield; some of the results may arrive in time for it, but it may be that only subsequent *bids will benefit from this feasibility demonstration*. Danesh, Roderich and myself are also preparing publications to introduce our concept— as soon as the data from this activity is available we will include the results in one of our publications and make the collected *data set available to the wider community*.

3 Budget

The request is for **£780** for electronic consumables to assemble two ground rovers, each equipped with LoRa transceivers, GNSS, and on-board computer (way-point control, telemetry, data logging). The materials are in stock at our standard suppliers and can be purchased as soon as funds are available. (I will use separate funds from my SR account to equip each rover also with Pycom's 8-channel gateway¹ when it becomes available later this summer.)



¹<https://pycom.io/product/pygate/>