Accurate Positioning: From Micro-Drones to Nano-Satellites

This talk will cover two research topics, at the first part of the talk we will cover a new approach for improving the accuracy of GNSS (aka GPS) devices in urban regions in particular for micro drones. In the second part of the talk we will cover a set of open problems related to accurate positioning and orientation algorithms for nano-satellites.

Commercial GNSS devices tend to perform poorly in urban canyon environments. The dense and tall buildings block the signals from many of the satellites. We present a particle filter algorithm for Shadow Matching framework to face this problem. Given a 3D city map and given the satellites' signal properties, the algorithm calculates in real-time invalid regions inside the Region Of Interest (ROI). This approach reduces the ROI to a fraction of its original size. We present a general framework for Shadow Matching positioning algorithm based on a modified particle filter. Using simulation experiments we have shown that the suggested method can improve the accuracy of existing GNSS devices in urban regions. Moreover, the proposed algorithm can be efficiently extended to 3D positioning in high sampling rate, inherently applicable for UAVs and Drones.

Free Space Optical Communication (FSOC) is a long range wireless communication based on laser. With expected bandwidth of many Gbps and energy efficiency significantly better than RF communication with only a fraction of the cost. This type of communication is mostly suitable for satellites and in particular nano-satellite communication. Yet, FSOC requires a clear LOS. Moreover, it requires an accurate aiming mechanism. More formally: given two points in 3D space (A,B) in order to perform an FSOC from A → B the laser at A should be directed towards B with an accuracy of mili-radian (0.07 degree). For that we need to know the positions of A and B and also need to have an accurate orientation sensors. In the mobile version of the problem A or B might be moving. Now, consider B to be a set of mobile points (nano-satellites). A need to maximaize the communication time to B – This can be seen as a mobile version of TSP problem – yet, during the talk we will show that this is actually a different problem which have several variants including M2M version which is hight motivated by real-world problems of nano-satellites swarm networks.

The first part of the talk is a join work with Roi Yozevitch and the second part of the talk is a work in progress with Miri Kedmi. The talk requires no background in satellite communication.