TITLE:

Track-and-Point Front-End for Drone Communication, Surveillance and Control

SEMESTER AND SEMESTER THEME:

ESD5 - Digital and analog systems interacting with the surroundings

BACKGROUND:

Front-End platforms with track-and-point capabilities of various kinds are key enablers for many applications. A non-exhaustive list includes application such as data and power transmission to/from High Altitude Platform Stations (HAPS) and other airborne stations, such as drones, capacity increase in wireless networks and various electronic warfare scenarios. Examples of such airborne stations are shown in Figure 1. To further detail the use of track-and-point systems a few slightly more specific uses are detailed below:

- Use of airborne stations to establish ad-hoc communication networks in emergency scenarios, such as after earthquakes and hurricanes, where existing infrastructures have been destroyed, which would greatly assist coordination of help
- Establish surveillance and intelligence networks to for instance secure perimeters by detecting intruders
- Establish general monitoring networks to track for instance environmental changes
- Establish solar panel farms at high altitude to vastly increase conversion efficiency and beam energy down to Earth - to save the World :-)
- Preventive measures to detect and shoot down hostile/interfering airborne stations [1]. This could also include finding/detecting a drone controller location.
- Improving link quality between a base station and moving object, such as a drone
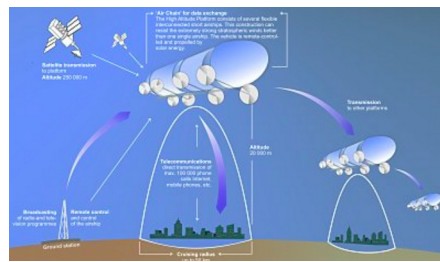
a) Example rendering of HAPS [2]

b) Drone used to deliver narcotics [3]

Figure 1: Examples of airborne stations.

CONTENT:

A common requirement for all the examples listed above is the ability to track the location of a moving object and to point 'something' in the direction of that object. The intention with this project proposal is therefore to have a functional track-and-point platform implemented. System requirements should/could be based on typical quadcopter-type drone performance. Inspiration to specific hostile/interfering uses of drones can easily be found as many companies, such as Danish myDefence [4], are working on preventive measures. If link quality optimization is the objective, many relevant system requirements may still be obtained from talks to for instance myDefence.

Realizing such a system presents a number of challenges and to address these the content of the project should/could include:

- Determining a suitable dynamic model of the target system
- Analysis and development of one or more "detect-and-point" algorithms
- Building a suitable simulation model to test and verify the developed control algorithms
- Implement a prototype system, or core-modules thereof, and test this against (for instance) a quadcopter as target platform

COURSE RELATIONS:

Depending on the focus chosen for the project, relations to courses may change. In general, topics of the three courses are central to the overall objective of the proposal and the relation between project and courses is therefore deemed high.

- Digital signal processing (**High**/moderate/low)
- Modeling and control (**High**/moderate/low)
- Communication systems (**High**/moderate/low)

REFERENCES:

[1] https://www.youtube.com/watch?v=sWItYuyxYts

[2] www.tao-group.de

[3] www.telegraph.co.uk/news/2017/08/20/man-charged-using-drone-smuggle-drugs-us/

[4] www.mydefence.dk

[5] www.businessinsider.com/a-startup-and-the-largest-defense-contractor-develop-anti-drone-tech-2017-8?r=US&IR=T&IR=T

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