**Project Proposal**

Phase 1 (estimated time: 1 month): Knowledge

1. Survey communication networks and protocols (Zig Bee, Bluetooth, 5G, 4G, wifi, ultra wide band, etc, ROS in a given applications) and other protocols in the literature useful in control applications.
2. Survey the literature on NCS. Check authors such as Heemels, Karl Johansson, Vijay Gupta, Dragan Nesic, Daniel Quevedo, Sandra Hirche, Joao Hespanha, etc.
3. Read my papers on NCS, 7 paper mentioned in http://www.dct.tue.nl/New/Antunes/research/networked-control-systems.html

Phase 2 (estimated time: 2 months): Model communication networks

1. Develop software to test nodes of several communication network (Zig Bee, Wifi, ultra wide band, …,4G) deemed suitable for control applications, make a nice software where one can easily test this. If working in ROS, e.g., make a 5G ROS node.
2. Build a model (or find in the literature and validate) of this communication protocols under different circumstances (different number of nodes, etc) based on statistical fitting or/and first principlies.

Phase 3 (2 month) Hardware

1. Use standard NCS tools (smith predictor, Kalman filter, etc) to control a robot (ground robot, drone, etc) with either delays of packet drops.

Phase 4 (2 months)

1. Integrate control tools in the NCS literature with the system that simulates and experimentally tests the communication networks. Hardware in the loop simulations. Eventually also integrate the experimental testbeds (whenever possible).

Phase 5 (1months)

1. Graphical interface to simulate and test NCS with hardware in the loop, combining what was learned in Phases 1-4.

Phase 6 Finalize (2 months)

1. wrap up experimental things. buy or use real control system and test the tool in real control systems

Possible collaboration with Haiming (MSc student), PhD from Dresden, Idelafonso