Summary

This research will focus on developing a fault-tolerant control system for auto-landing of a quadrotor UAV on moving vehicles. The problem is subject to different challenges which should be carefully studied. As the first issue, the control system must lead to a robust behavior under different types of operational faults and atmospheric disturbances including turbulence, wind gusts, and wind shear. This can be performed using either a baseline controller, which is augmented by the information obtained using a Fault Detection and Isolation (FDI) block and a disturbance observer, or by designing an adaptive control system in an integrated manner without estimating the faults, directly.

On the other hand, there are a variety of model-based control schemes (such as the backstepping method, the feedback linearization, etc.) versus model-free approaches (such as those based on artificial neural networks, the fuzzy control, the reinforcement learning, etc.) or combinations of them. Concerning the topic of this research, there is a need to decide about the structure of the control system after a careful literature survey according to the different requirements of the project.

Besides, the VTOL *landing*, itself, is subject to several challenges such as the consideration of the ground effect. The problem becomes more challenging in the case of a moving platform. Accordingly, it may also be a requirement for a re-decision about the necessary sensors to be mounted on the UAV to provide a soft landing on a moving vehicle.

After designing the control system, the closed-loop stability should be mathematically analyzed. Subsequently, the designed controller would be implemented on MATLAB/Simulink to evaluate the closed-loop performance in different flight simulations under different flight conditions, and finally, it will be coded on an onboard processor placed on a quadrotor UAV to assess the performance of the developed control strategy in a real application.