NEXT LEVEL INNOVATION IN ROBOTICS AND AUTONOMY

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Title: **Autonomous Autorotation for Fail-safe Aerial Robot**

Small unmanned aerial robots are fast crowding up the airspace for wide range of civilian and military applications such as aerial surveillance, search and rescue, disaster management, emergency healthcare, precision agriculture to name a few. Several of these applications would requires these aerial robots, some of which may be weighing over 10s of kilos, to fly over inhabited areas. To ensure safety these aerial robots need to demonstrate fail-safe modes to minimize or eliminate accidental damages in the event of failure. This talk focuses of development of fail-safe features for an unmanned small helicopter type aerial robot in the event of power failure or tail rotor failure or transmission failure. Either of these three failures may cause the 10 kg helicopter to come crashing to the ground. To ensure fail-safe the helicopter must perform the autorotation maneuver which is a common emergency procedure taught to helicopter pilots as part of their training. In this the helicopter is operated in unpowered condition and the potential and kinetic energy stored in the rotor is utilized to operate the helicopter rotor like a wind mill and enable it to land safely on ground.

First, the aerodynamics of autorotation maneuver which is a highly non-linear maneuver would be explained. Next, a new approach proposed for identification of the plant dynamics during autorotation would be discussed. Next, the setup of hardware-in-the-loop-simulation (HILS) for autorotation using the identified model is detailed. PID controller is tuned in the HILS environment for autonomous autorotations. Finally, the controller designed using HILS is validated in flight test for autonomous autorotative landing.