

Design, modelling and realization of a compliant enclosure for swashplateless coaxial aerial vehicles colliding at high speeds

Abstract: Coaxial aerial vehicles relying on swashplateless mechanism have proven to be able to emulate full actuation over forces and torques (six degrees of freedom) without a complex actuation design. Exploiting their smaller size, lightweight and controllability peculiarities, compared to standard quadcopters, this work focuses on the collision-tolerant properties of such design. The goal is to realize a compliant embodiment that permits the system to collide at very high speed without any repercussions.

Tasks:

- Study and understand the basic swashplateless mechanism
- Improve and test a coaxial swashplateless MAV prototype.
- Extend previous work with advanced modeling dynamics and control
- Realize a compliant protective embodiment allowing high-speed collisions

Literature (indicative):

- [1] Paulos J, Yim M. *Flight performance of a swashplateless micro air vehicle*. In 2015 IEEE International Conference on Robotics and Automation (ICRA) 2015 May 26 (pp. 5284-5289). IEEE.
- [2] Paulos J, Yim M. *Cyclic blade pitch control for small UAV without a swashplate*. In AIAA Atmospheric Flight Mechanics Conference 2017 (p. 1186).
- [3] Paulos J, Caraher B, Yim M. *Emulating a fully actuated aerial vehicle using two actuators*. In 2018 IEEE International Conference on Robotics and Automation (ICRA) 2018 May 21 (pp. 7011-7016). IEEE.
- [4] Qin Y, Chen N, Cai Y, Xu W, Zhang F. *Gemini II: Design, Modeling, and Control of a Compact Yet Efficient Servoless Bi-copter*. IEEE/ASME Transactions on Mechatronics. 2022 Mar 16;27(6):4304-15.

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