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A Method to Compute Efficient 3D Helicopters Flight Trajectories Based On a Motion Polymorph-Primitives Algorithm

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Abstract : Finding the optimal 3D path of an aerial vehicle under flight mechanics constraints is a major challenge, especially when the algorithm has to produce real-time results in flight. Kinematics models and Pythagorian Hodograph curves have been widely used in mobile robotics to solve this problematic. The level of difficulty is mainly driven by the number of constraints to be saturated at the same time while minimizing the total length of the path. In this paper, we suggest a pragmatic algorithm capable of saturating at the same time most of dimensioning helicopter 3D trajectories' constraints like: curvature, curvature derivative, torsion, torsion derivative, climb angle, climb angle derivative, positions. The trajectories generation algorithm is able to generate versatile complex 3D motion primitives feasible by a helicopter with parameterization of the curvature and the climb angle. An upper "motion primitives' concatenation" algorithm is presented based. In this article we introduce a new way of designing three-dimensional trajectories based on what we call the "Dubins gliding symmetry conjecture". This extremely performing algorithm will be soon integrated to a real-time decisional system dealing with inflight safety issues.

Keywords : robotics, aerial robots, motion primitives, helicopter
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