System Design on Hybrid Locomotion of Hexapod Robot and Quad-Rotor Flying Robot

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Abstract: Firstly, a novel hexapod robot (E-beetle) with wheel-legged hybrid locomotion system is presented, leg with wheel in the shank is the vital feature of E-Beetle which possesses good terrain adaptability and high mobile efficiency. It can walk with various gaits, move with wheels, manipulate using legs as arms, and self-recover when overturned. The adaptive gait planning method for hexapod robot with wheel-legged locomotion is proposed. By simulations and experiments, it is verified that the hexapod robot can change its gait to adapt the environment. The robot control system is developed based on ROS, which can be operated by mobile phone or PC through Wifi. Secondly, a quasi-rotor flying robot (Manifolder) which consists of a quadrotor endowed with dual manipulators is proposed. It is designed with many advanced functions like wall-climbing, flying-walking, aerial manipulating etc. A new approach to control the attitude of a quadrotor aircraft in terms of the exponential coordinates is developed. The exponential coordinate is a minimal representation of the rotation matrix, but it can avoid singularities. Considering the coupling dynamics between the arm/legs and main-body subsystems, the kinematics and dynamics of the overall system of MMAR are formulated. By dividing the flying-manipulating/walking locomotion into different modes, the control of MMAR in each mode is designed. We have developed several successful prototypes, including hardware, software and GCS. The global tracking controller is applied to Manifolder with good performance in experiments.