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Aerodynamic control with passively pitching wings NICK GRAVISH, ROBERT WOOD, Harvard University — Flapping wings may pitch passively under aerodynamic and inertial loads. Such passive pitching is observed in flapping wing insect and robot flight. The effect of passive wing pitch on the control dynamics of flapping wing flight are unexplored. Here we demonstrate in simulation and experiment the critical role wing pitching plays in yaw control of a flapping wing robot. We study yaw torque generation by a flapping wing allowed to passively rotate in the pitch axis through a rotational spring. Yaw torque is generated through alternating fast and slow upstroke and and downstroke. Yaw torque sensitively depends on both the rotational spring force law and spring stiffness, and at a critical spring stiffness a bifurcation in the yaw torque control relationship occurs. Simulation and experiment reveal the dynamics of this bifurcation and demonstrate that anomalous yaw torque from passively pitching wings is the result of aerodynamic and inertial coupling between the pitching and stroke-plane dynamics.

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