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Effect of design parameters on the flight dynamics of a Kiteplane

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Realizing the potential of the pumping kite power system as a concept for airborne wind energy generation requires a kite that is not only agile and aerodynamically efficient to maximize the power output, but also stable to minimize the control effort. In addition, a low lift mode – in kite terminology called depower – is necessary to implement a swift low power consuming downstroke. A kite that may fulfill these needs is the Kiteplane, an airplane-shaped kite constructed with inflatable beams and canopy surfaces.
This lightweight airframe is connected to the ground station with a single-line tether and supported by lateral bridle lines. The lateral bridle couples the roll and yaw motion as a function of the pitch attitude with respect to the tether.

Simulating the 5-DOF model of the single-line single-kite system reveals that the amount and distribution of lateral aerodynamic surface area is decisive for flight dynamic stability. Furthermore, a power cycle of the geometrically optimized Kiteplane, with elevator and rudder control, yields an average power output of 1 kW/m2 and a capacity factor of 0.6 at a constant wind velocity of 10 m/s.