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Minimum Wind Dynamic Soaring Trajectories under Boundary Layer Thickness Limits GABRIEL BOUSQUET, MICHAEL TRIANTAFYLLOU, JEAN-JACQUES SLOTINE, Massachusetts Inst of Tech-MIT — Dynamic soaring is the flight technique where a glider, either avian or manmade, extracts its propulsive energy from the non-uniformity of horizontal winds. Albatrosses have been recorded to fly an impressive 5000 km/week at no energy cost of their own. In the sharp boundary layer limit, we show that the popular image, where the glider travels in a succession of half turns, is suboptimal for travel speed, airspeed, and soaring ability. Instead, we show that the strategy that maximizes the three criteria simultaneously is a succession of infinitely small arc-circles connecting transitions between the calm and windy layers. The model is consistent with the recordings of albatross flight patterns. This lowers the required wind speed for dynamic soaring by over 50% compared to previous beliefs. In the thick boundary layer limit, energetic considerations allow us to predict a minimum wind gradient necessary for sustained soaring consistent with numerical models.

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