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Fan array wind tunnels: turbulence on-demand[1] CHRISTOPHER DOUGHERTY, ALEJANDRO STEFAN-ZAVALA, PETER RENN, MORTEZA GHARIB, Caltech — Naturally-occurring winds are distinctly unsteady and non-uniform, particularly in complex urban airscapes. To better understand flight in these contexts, it is imperative to be able to control wind profiles in a predictable, repeatable, and representative manner. This can effectively be accomplished with fan array wind tunnels (FAWT), a modularly built multi-source wind tunnel capable of generating a host of spatiotemporally-varying flows via software interfacing. Utilizing an array of DC-powered off-the-shelf cooling fans (in place of one singular drive section) allows for greater flow control, overall decreased mixing lengths, and comparably large useable test section areas when compared with its effective footprint. Tunnel resolution along with fan responsiveness determines the effectiveness of one of its most salient features: the ability to tailor turbulence around a desired a mean (i.e. turbulence on-demand). This decoupling adds new territories to explore in simulated flight contexts. Periodic and unsteady flows will be highlighted with brief considerations given to the future role of machine learning.

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