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An adaptive control process for the temporal shaping of a jet in cross flow[1] STEPHEN SCHEIN, TAKESHI SHOJI, ANN KARAGOZIAN, ROBERT M'CLOSKEY, UCLA — This study demonstrates an iterative process for shaping the temporal exit velocity for a gaseous jet in crossflow (JICF). Alternative temporal velocity waveforms, typically measured via hotwire anemometry at the center of the nozzle exit, can significantly affect JICF mixing characteristics[2]. The most challenging waveforms to create are those with rapid transitions in the jet velocity, e.g., single- and double-pulse square waves. While linear models of the jet velocity actuation can be empirically determined and used, in practice they yield poor reproductions of the desired waveforms because the jet velocity is a highly nonlinear function of the actuation variable. This research presents an approach to improve waveform control by using the periodicity of the desired velocity deviation relative to the mean jet velocity. A local model relating perturbations of the harmonics in the input variable to jet velocity harmonics is empirically determined, providing a means to adjust the input harmonics so that the jet profile converges to the desired signal. The process is necessarily iterative because the local model must be re-identified at each new operating point, but the scheme converges rapidly under a variety of flow conditions.

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[2]Shoji, T., Ph.D. Dissertation, UCLA, 2017

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