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Active Flow Control of Large Separation: A New Look at Scaling Parameters. J. KIEDAISCH, B. DEMANETT, H. NAGIB, IIT, USA — Recently, there have been significant advances in the application of various methods of Active Flow Control (AFC) for controlling separated flows. The most popular method of AFC used recently is Zero-Mass Flux (ZMF). Traditionally, the scaling parameters used to evaluate effectiveness of ZMF control have been the momentum coefficient C_μ and the non-dimensional frequency F^+. While this scaling has worked well for certain types of flows, i.e. flows with small separated regions, exhibiting separated shear layers susceptible to instabilities and development of coherent structures, it is not the proper choice for flows with large separated regions, especially with three dimensionality and high Reynolds numbers. This became evident in a couple of recent tests where ZMF was used with large separated regions, including the first ever full-scale flight demonstration of AFC; the DARPA/Boeing/Bell Helicopter XV-15 download reduction program. The key element in this program and others, where AFC technology is transitioned from small-scale laboratory tests to large-scale tests and eventually to full-scale flight, was the realization that traditional scaling parameters did not apply, and a new way of characterizing the performance of AFC was needed. This new way of thinking, where the dominant parameter is the ratio of the peak AFC jet velocity to the local flow velocity, has lead to advances in development of new AFC actuators and concepts, including Adaptive Intermittent Suction Control of Separation (AISCOS).

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