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Performance Enhancement of a Vertical Tail Using Synthetic Jet Actuators: Flow Physics NICHOLAS RATHAY, Rensselaer Polytechnic Institute, EDWARD WHALEN, Boeing, MICHAEL AMITAY, Rensselaer Polytechnic Institute — Using aerodynamic flow control techniques, it is possible to reduce the severity or even eliminate the flow separation that occurs over the rudder of a vertical tail on a commercial airplane when it is deflected to high angles. Decreasing the extent of separated flow would result in a larger side force generated by the tail. This could allow for the size of the tail to be reduced, decreasing the overall weight and drag, and potentially creating considerable savings in fuel costs. In this work, wind tunnel experiments were conducted at Rensselaer Polytechnic Institute on a $1/19^{\text{th}}$ scale model of a vertical tail. It was shown that synthetic jet (zero-net-mass-flux) actuators were capable of decreasing the separated flow over the rudder and increasing the side force. Furthermore, Stereo Particle Image Velocimetry was used to understand the interaction of the synthetic jets with the flow over the rudder. The measurements showed regions of reduced and enhanced velocity (relative to the baseline) in the vicinity of the jet trajectory. These regions were believed to in part be the result of an interaction between the synthetic jets' edge vortices and the crossflow. The data suggested that in this application the synthetic jet flow control system could more effective at augmenting side force if the jet orifices were designed or aligned in such a way to modify the weighted contribution of these vortices.

Michael Amitay
Rensselaer Polytechnic Institute

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