

## Active Flow Control in Axial Fans

Axial fans are a basic component in most industrial ventilation and cooling systems. Although they are designed to operate at optimal conditions, they often operate under adverse conditions resulting in fan stall that accounts for approximately 25% of industry losses. Fan stall is a cyclic phenomenon that may result in fatigue crack formation and, if the system surges, the fan may fail mechanically. Consequently, larger, less efficient fans are forced to operate “deep” in the stable region of the fan characteristic or bulky, expensive and inefficient stall control systems must be implemented. Recent legislation on the matter proves that a more efficient solution is required. The source of fan blade stall is boundary layer flow separation and research on stationary airfoils and wings has conclusively demonstrated that the introduction of periodic perturbations can excite flow instabilities and significantly ameliorate the flow separation. This research is aimed at developing a dynamically-deployed on-blade stall control systems within a dedicated axial flow experimental facility. The means chosen to excite the flow are pulsed dielectric barrier discharge (DBD) plasma actuators. They consist of thin electrodes separated by a dielectric material, and they are light and easy to implement. Results will be presented of fan operation with and without pulsed DBD plasma actuation. The effects of ionization voltage, reduced frequency and pulsation duty cycle will be presented. Finally, the net benefit to the machine in terms of operational range and efficiency will be considered.

