Control of dynamic stall in a wide range of Mach numbers by nanosecond surface dielectric barrier discharge plasma actuators

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High speed helicopters must accommodate significant changes in the rotor lift performance as a function of rotor angle. The advancing blade can achieve transonic conditions while the retreating blade experiences relatively low speed. The high Mach number of the advancing blade requires an angle of attack below 5 degrees for maximum lift, whereas the retreating blade requires high an angle of attack in excess of 10 degrees. Under high speed and high load conditions, stall occurs during the retreating cycle and destabilizes the aircraft. Thus operation requires that the angle of attack of the blades be changed during the cycle and optimized with flight speed. The focus of this research is to determine to what degree plasma actuators can be used to optimize high speed flight performance, particularly focusing on suppressing the dynamic stall by retreating blade separation control.