Actuation of a Reconfigurable Shape Memory Alloy Airfoil during Stages of Flight for a Commercial Aircraft

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In commercial aviation any change that makes an aircraft even 0.1% more efficient saves the company money when multiplied by the number of aircraft used. The purpose of this experiment was to use Smart Metal Alloys (SMA) to actively change the shape of an airfoil to help reduce drag throughout the stages of an aircraft's flight and improve efficiency. The hypothesis was if the camber of an airfoil is increased using SMA then so will the drag. A model airfoil using a SMA actuator was created to prove the design concept. This change corresponded to change in airfoil camber from a NACA 0012 to a NACA 1412 and then to a NACA 2412 airfoil. These designs were then tested for Theoretical Coefficient of Lift (CL) and Coefficient of drag (CD) in the Xfoil computer program at increasing angle of attack (AOA). The CL at 20 degree was 0.5316, 0.8775 and 0.9336 with a CD of 0.21166, 0.25764 and 0.25600 respectively. At most AOA, as the camber increased so did the CL as well as the CD. The 3 airfoils were then tested in a homemade low speed wind tunnel at 5m/s and the drag was measured. The drag for the airfoils at an AOA of 20 degrees was 18.33, 23.67 and 20.00 grams. The wind tunnel data confirmed the theoretical data. This proved that at most angles of attack that as the camber of the airfoil increases using a SMA actuator the lift and drag increased.