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WIND TUNNEL TEST OF DIELECTRIC ELASTOMER ACTUATOR FOR MARS AIRPLANE

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Dielectric elastomer (DE) is a relatively new transducer technology uses rubberlike polymers (elastomers) as actuator materials. The basic element of DE is a very simple structure comprised of a thin elastomer sandwiched by soft electrodes. When a voltage difference is applied between the electrodes, they are attracted to each other by coulomb forces leading to a thickness wise contraction and plane wise expansion of the elastomer. At the material level, DE actuator has fast speed of response, with a high strain rate, high pressure and power density of 1 W/g. Recently, airplanes are paid attention as a new platform for Mars exploration. The Mars airplane must be lightweight to fly using aerodynamic forces in the rarefied Martian atmosphere. Therefore light-weight and high-power actuators are required for the Mars airplane. The advantages of the DE actuators are beneficial for the Mars airplane. The DE actuators have a possibility to be used as actuators for control surfaces (i.e. ailerons, rudder, and elevator) and a propeller of the Mars airplane. This research reports a result of a wind tunnel test of a control surface actuation using DE actuator to investigate a feasibility of the DE actuators for the Mars airplane. A chord length of the wing is 160 mm, including the control surface of 55 mm. A Ø80 mm, diaphragm-shaped DE of 0.1 g is used. Bias voltages are from 3.2 to 3.7 kV. Angles of attack are from -10° to 10°. Flow velocities are 0, 10, and 15 m/s. Deflection angles of the control surface are measured. The result shows that the control surface is sufficiently actuated by DE actuator under various flow conditions

Biography

Koji Fujita has received his BSc degree in Aerospace Engineering from Tohoku University in 2010 and pursued PhD at Tohoku University under the supervision of Professor Hiroki Nagai. His research focussed on an airplane for Mars exploration. His thesis work involves the conceptual design of the Mars airplane and aerial deployment technique. He continued this research at Japan Aerospace Exploration Agency as a Research Fellowship for Young Scientists of Japan Society, for the Promotion of Science. Now, he is serving as an Assistant Professor at the Institute of Fluid Science at Tohoku University. He started a joint research with Co-Authors to utilize dielectric elastomer actuators for his airplane for Mars exploration.

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