

Critical speeds for carbon/epoxy composite rotors in spacecraft energy storage applications

ABSTRACT

A numerical investigation to optimize the carbon/epoxy multi layer composite rotor is performed for the spacecraft energy storage application. A high-speed double and triple layer rotor design is proposed and different composite materials are tested to achieve the most suitable recipe. First, analytical rotor evaluation was performed in order to establish a reliable numerical composite rotor model. Subsequently, finite element analysis is employed in order to optimize the double and triple layer composite rotors. Then, the modal analysis was carried out to determine the rotor natural frequencies. The rotor stress distributions and the rotor mode shapes show that a safe operational regime below 46, 000 rotations per minute is achievable.

Keyword: Energy storage; Finite element analysis; Multi layer rotor; Spacecraft flywheel