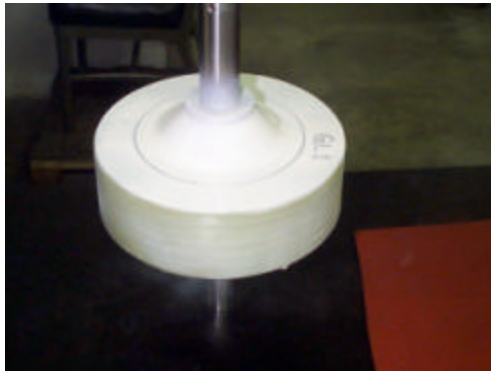


# Design of Composite Flywheel Rotors with Soft Core

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A flywheel is an inertial energy storage system in which the energy or momentum is stored in a rotating mass. Over the last twenty years, high-performance flywheels have been developed with significant improvements, showing potential as energy storage systems in a wide range of applications. Despite the great advances in fundamental knowledge and technology, the current successful rotors depend mainly on the recent developments of high-stiffness and high-strength carbon composites. These composites are expensive and the cost of flywheels made of them is high.

The ultimate goal of the study presented here is the development of a cost-effective composite rotor made of a hybrid material. In this study, two-dimensional and three-dimensional analysis tools were developed and utilized in the design of the

composite rim, and extensive spin tests were performed to validate the designed rotors and give a sound basis for large-scale rotor design. Hybrid rims made of several different composite materials can effectively reduce the radial stress in the composite rim, which is critical in the design of composite rims. Since the hybrid composite rims we studied employ low-cost glass fiber for the inside of the rim, and the result is large radial growth of the hybrid rim, conventional metallic hubs cannot be used in this design. A soft core developed in this study was successfully able to accommodate the large radial growth of the rim. High bonding strength at the shaft-to-core interface was achieved by the soft core being molded directly onto the steel shaft, and a tapered geometry was used to avoid stress concentrations at the shaft-to-core interface. Extensive spin tests were utilized for reverse engineering of the design of composite rotors, and there was good correlation between tests and analysis. A large-scale composite rotor for ground transportation is presented with the performance levels predicted for it.