Design and Optimization of a hub for a CFRP disk rotating at a very high speed

The Institute of Lightweight Structures of the Faculty of Mechanical Engineering at Technische Universität München has been designing and producing carbon fiber reinforced polymer (CFRP) chopper disks for over a decade, specializing in designs for light disks with a high rotational speed. Chopper disks are commonly used in neutron time-of-flight spectroscopy. They are disks with one or more cut-outs rotating around an axis parallel to the neutron beam, reaching rotational speeds of up to 450 Hz. In order to connect the disk to the shaft, a hub is needed. To avoid additional stress in this already highly stressed area of the laminate, a friction-fit connection between the aluminum hub and the CFRP disk is chosen. During rotation, the central drilling in the disk widens itself more than the hub, the disk thus being detached from the hub. To avoid this detachment, multiple numerical analyses and optimizations are made in order to find a mechanism that allows for the hub to remain in contact with the disk even at high rotational speeds. The newly developed design of the hub has been experimentally tested and validated. The results of the numerical analysis, the optimization and the
experimental data are presented in this paper.

Stichworte:  
CFRP; Chopper Disk; Shaft-hub connection, MDO

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