Flight Testing of a Coaxial Ultralight Rotorcraft

Abstract:
The results of a full-scale flight test on an ultralight counter-rotating coaxial rotorcraft, the CoAX 2D, are presented. The CoAX 2D was developed and manufactured by edm-aerotec in Geisleden, Germany. It can be operated up to a maximum take-off weight of 450 kg. The helicopter features 2-bladed, 6.5 m diameter upper and lower rotors in teeter configuration with uniform airfoil sections and linearly twisted blades. Fundamental measurements included air data, data from an inertial measurement unit, control forces and deflections, and tail-boom loads in the nonrotating system as well as upper- and lower-rotor teeter angles and data from blade and hub-load instrumentation. Flight data was synchronized by a common time stamp that was recorded in each system and an additional rotor position pickup sensor. A semiautomated, steady-state recognition algorithm facilitated the evaluation of the results within chosen limitations, accounting for the rotorcraft’s position, speed, and attitude in space. This paper explains how flight test data of a coaxial ultralight rotorcraft were processed and it presents results from extensive flight testing. The current focus is on hover and forward flight tests during which the CoAX 2D’s power consumption, control angles, tail
loads, hub loads, and teeter angles for the whole range of flight speeds were analyzed and evaluated. Upper- and lower-rotor thrust-sharing characteristics as a function of flight speed were analyzed and the resulting rotor–rotor interferences were identified. Hover was dominated by 2/rev characteristics from rotor-fuselage interference.