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Interactions of a Propeller with a Circumferentially-Varying Flow
JOHN FARNSWORTH, US Air Force Academy, MICHAEL AMITAY, Rensselaer Polytechnic Institute, DAVID BEAL, STEHPEN HUYER, Naval Undersea Warfare Center, Newport — The interactions of a circumferentially varying stator cascade and a downstream fixed pitch propeller were investigated experimentally in a water tunnel using the Stereoscopic PIV technique. A cyclic distribution of the stators' deflections resulted in non-axisymmetric distributions of the flow field downstream of the stator array. The stator distribution alone produced a significant side force that increased linearly with stator pitch amplitude. When a propeller was incorporated downstream from the cyclic cascade the side force from the stator cascade was reduced, but a small normal force and pitching moment were created. The generation of these secondary forces and moments can be related to the redistribution of the tangential flow from the cyclic cascade into the axial direction by the retreating and advancing blade states of the fixed pitch propeller. The Q criterion was utilized with measurements phase-locked to the propeller frequency to visualize the interactions of the vortical structures in the wake of the combined stator-propeller system.

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