DOCUMENTATION SHEET

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Title : **A 4-DOF WHIRL FLUTTER ANALYSIS OF TRACTOR AND PUSHER (SARAS) TYPE PROPELLER NACELLE SYSTEM OF AIRCRAFT**

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Abstract:

A four-degree of freedom model (pitch, yaw and two off the propeller plane deformations from blade flexibility) has been used for flutter analysis of the propeller-nacelle assembly. The formulation, originally based on a tractor configuration, has been modified to include the pusher configuration of the SARAS. Explicit mathematical expressions have been derived. An in-house computer code in MATLAB has been prepared and benchmarked with results of the 2 DOF model for the tractor configuration of the report NASA TN D-659 in which blade flexibility has been eliminated. Results have been generated for different altitudes of flight For each altitude, the Advance Ratio values *(J=V/2nR)* have been specified. At neutral stability, the forward and backward whirl frequencies and the corresponding necessary damping g_θ for stability boundary conditions at the speed V are generated.

The present model predicts that the configuration of the SARAS propeller assembly with rigid blades is quite stable in whirling motion. Results have been generated for various altitudes of flight with variable hypothetical blade flexibility and support stiffness values. From these parametric studies, it has been observed that reduction in structural stiffness leads to an increase in the critical damping in backward whirl at the stability boundary. Stability is ensured when the experimentally determined damping exceeds critical damping. Critical condition in terms of the lower bound of stiffness of the rotor-propeller assembly has been estimated.