NASA TECH BRIEF

Langley Research Center

Effects of Nonuniform Swash-Plate Stiffness on Coupled Blade-Control System Dynamics and Stability

The problem:

In the dynamic analysis of a single rotor blade, one parameter which is always open to question is the effective control system stiffness. This parameter is frequently determined through trial and error in order to get results that are compatible with experiments. Furthermore, for a given blade the effective value is generally different, depending on the vibration mode being tested.

The solution:

A program has been developed that analytically determines the effects of a nonuniform swash-plate support stiffness, swash-plate flexibility, and out-of-blade track on the vibratory mechanical stability characteristics of helicopter rotor systems.

How it's done:

The analysis is based on a combined Laplace transform and associated matrix approach. The program yields complex eigenvalues which indicate frequency and rate of growth or decay of a natural mode of the complex system. Blade modal response and swash-plate motion corresponding to a given eigenvalue are predicted.

With the present analysis there are no provisions for applied aerodynamic loads or for perturbation aerodynamics as a result of blade motions. Thus, all analytical results obtained are effectively those for a rotor in a vacuum. However, the analysis and programs have been developed so as to be directly useful in more extensive aeroelastic computer programs which are yet to be developed.

Notes:

1. This program is written in FORTRAN IV for use on the CDC-6600 computer.
2. Inquiries concerning this program should be directed to:

   COSMIC
   112 Barrow Hall
   University of Georgia
   Athens, Georgia 30601
   Reference: LAR-11068

Source: Vincent J. Piarulli of
Rochester Applied Science Associates, Inc.
under contract to
Langley Research Center
(LAR-11068)

Category 06, 09