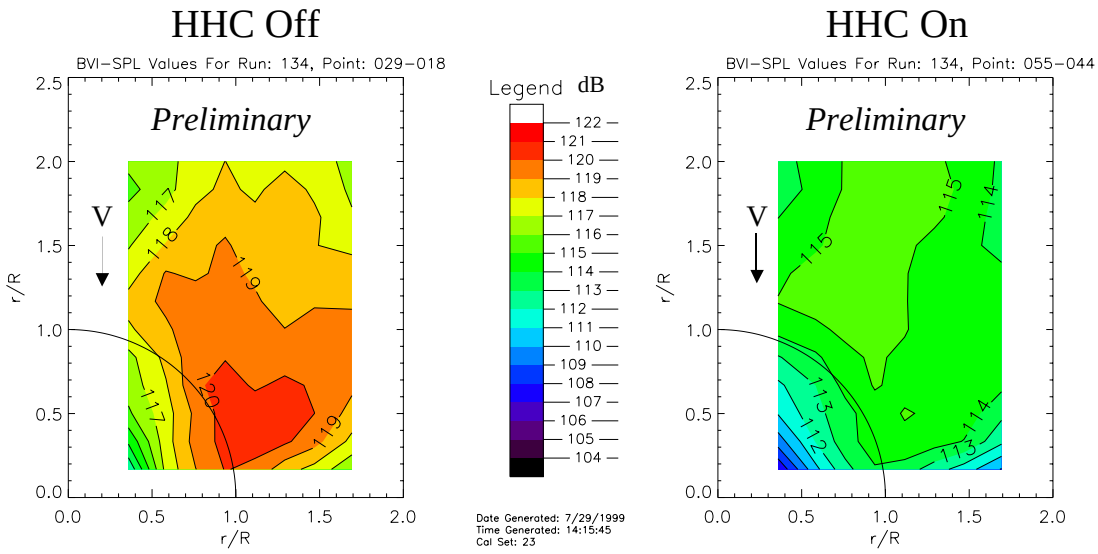
Tilt Rotor Noise Reduction

POCs: Mark Betzina, Code ARA, ext. 4-5106
Cahit Kitaplioglu, Code ARA, ext. 4-6679
Khanh Nguyen, Code ARA, ext. 4-5043
RTOP: 576-03-14



XV-15 Closed-Loop HHC Noise Reduction in Advancing Side Upstream Quadrant
(Preliminary Data, Tip-Path-Plane Angle = 3 deg., Adv. Ratio = 0.17, Ct/s = 0.09)

Background

Tilt-rotor noise reduction is a major element of the Short Haul Civil Tiltrotor (SHCT) Program. An 80x120 Wind Tunnel test of both a 3-blade and 4-blade XV-15 rotor in helicopter-mode flight to investigate Blade Vortex Interaction (BVI) noise reduction techniques is a level 1 milestone of the SHCT program.

Objectives

Primary test objectives are to investigate BVI noise reduction using several different configurations of subwings attached to the blade tips, both open-loop and closed-loop Higher Harmonic Control (HHC), and a 4-blade XV-15 rotor.

Accomplishment

The 3-blade XV-15 rotor was tested on the Rotor Test Apparatus (RTA) in the 80x120 Wind Tunnel over a range of typical tilt-rotor approach flight conditions. BVI noise levels and directivity were measured for the baseline rotor, several subwing configurations, and with both open-and closed-loop HHC. Rectangular subwings were tested at two different incidence angles and a Bell Helicopter advanced subwing design was also tested. Preliminary results indicate that the subwings tested have very little effect on BVI noise. However, a 4.5 dB BVI noise reduction (see figure) was achieved with closed-loop HHC using blade pressure transducers for feedback. Open-loop results suggest that larger noise reductions can be achieved with higher amplitude HHC, which is limited on the current test hardware by control system loads. Laser light sheet flow visualization was used to obtain images of the parallel vortex interaction responsible for the highest BVI noise levels.

Future Plans

Similar testing with a 4-blade XV-15 rotor will be accomplished in April, 1999.