DISCUSSION

T. H. Okiishi

The results presented in this paper undoubtedly represent a great deal of effort. Hot-wire and flow field pressure measurements in the relative frame of reference in a turbomachine require much skill and patience. As mentioned by the authors, detailed information about turbomachinery blade wake development is important for competently calculating blade flow field interaction effects. Recent developments in measuring equipment and procedures, including the system described in this paper, are resulting in the accumulation of this kind of data. This is interesting to consider wake development, as these authors have done, in a research compressor with the blade rows spaced rather far apart. However, when turbomachinery blade rows are placed more closely together several important phenomena can occur. Walker and Oliver [17] observed that the exit flow of a rotor can be affected by the potential flow field of the downstream stator row. Several investigators [17-23] have noted that chopped and transported blade wakes can appreciably affect the chopping blade wake flow. Interaction noise levels [24, 25] and stage efficiencies [26, 27, 28] have been observed to increase with decrease in blade row gap. In view of these considerations, gap width should be an important variable in studies like the one described in this paper.

It would be of interest to know if the authors analyzed the variation of the higher harmonic Fourier coefficients $A_2$, $A_3$, and $A_4$ with downstream distance. This kind of information would be useful for determining what portion of the harmonic content of the developing wake is significant at various distances downstream from the trailing edge. The main controlling factor seems to be the section-drag coefficient of the blades. The width as well as the decay correlate well with $V_{cd}$.  

Acknowledgments

This work was supported by the National Aeronautics and Space Administration, through the grant NSG 3012, with M. F. Heidmann as the technical monitor. The authors wish to acknowledge G. Kane and J. Rishel for their aid in experimental set-up and S. Kovicic for his help in data processing.

References

edge of the wake producing blade. Lowson [29] and Homicz, et al. [30] suggested that immediately behind a blade, all harmonics of the wake velocity profile are important but at larger distances downstream only the first harmonic is significant.

Additional References


Author’s Closure

The authors wish to thank Professor Okiishi for the discussion of the paper. Though some compressors have small inter stator-rotor spacing, there are many fan stages (e.g., JT9D, CF6, RB211, etc.) which have two to three chord spacing between the rotor and the stator. It is of interest to know how the wakes develop and decay with such large spacing. Once the mechanism of decay of the wake and its contribution to the acoustic levels are understood at such large spacings, it is possible to effectively study the wake behavior at smaller spacing and account for the potential interaction with the downstream stator.

The authors have analyzed the variation of higher Fourier coefficients up to $A_7$ and have found for the two sets of rotors [1, 2] that the predominant harmonics are up to $A_5$ in the trailing-edge and near-wake regions and only the first two in the far-wake region.