A NOVEL INSTRUMENTATION SYSTEM FOR MEASUREMENT OF HELICOPTER ROTOR MOTIONS
AND LOADS DATA

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Abstract

Recent U.S. Navy-sponsored research has led to the development of a blade-mounted instrumentation system that incorporates several novel features in support of use for Dynamic Interface flight testing applications. The instrumentation incorporates accelerometer sensors for measurement of both blade aeroelastic deflections as well as applied aerodynamic measurement modules that transmit their serial data using an infra-red (IR) link to the helicopter fuselage. Design issues that incorporate requirements for low-cost, ease of installation and removal, self-contained power sources, and secure datalink transmission are detailed and described.

INTRODUCTION

U.S. Navy rotary-wing flight training and operational evaluation requirements have been aided through extensive use of manned flight simulators. These simulations can provide sufficient realism to reduce the number of operational flight hours required for flight and weapons system training, as well as provide scenarios and environmental factors that would be difficult or impossible to achieve on an as-needed basis. With the ever-increasing computational capability in modern simulators, it has become possible to add additional realism by including more complex physical models for the systems represented by the simulator's computers. However, the addition of simulator model sophistication directly impacts the level of detail required in the measurements and data used for correlation with these simulation models. The ultimate application of the system described here is to provide a simplified means of acquiring rotor motion and loads data, using a combination of accelerometer sensors and a Kinematic Observer signal processor, to provide rotor blade motion and loads data that approach this ideal in aircraft application independence.

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Background into the original concept of the use of an accelerometer-based measurement approach for extracting blade motions and loads data was given in an earlier AHS paper. The work described here represents an extension of that effort that culminated in the testing of the system on a full-size, man-capable rotor system. Further developments of the theory used in the processing of the accelerometer sensor signals, design of the telemetry system, issues related to the selection of the data converters, and the details of the actual test are given in the sections that follow.