

commodate the effects of the varying surface velocity, thermal crowning, centrifugal dishing, and misalignment. Rectangular tabs on the foil blanks fit into the backing plate slots.

For this application, a rather traditional set of conventionally machined dies is selected, and bump foil blanks are pressed into the dies for forming. This

arrangement produces a set of bump foil dies for foil thrust bearings that provide for relatively inexpensive fabrication of various bump configurations, and employing methods and features from the public domain.

*This work was done by Brian Edmonds and Christopher DellaCorte of Glenn Research Center and Brian Dykas of Case Western Reserve*

*University. Further information is contained in a TSP (see page 1).*

*Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18397-1.*

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## Miniature Multi-Axis Mechanism for Hand Controllers

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A hand controller provides up to three axes of motion, and all required feel characteristics (stiffness and breakout torques) located inside a hollow handle within the grip of the hand. This is achieved using a miniature gimbal mechanism that allows for independent motion about one, two, or three axes within the grip volume of the hand, and miniature flexure assemblies co-located with the gimbal mechanism that provide substantial stiffness and breakout torques in each axis of motion. Also, miniature sensors can be integrated into the gimbal mechanism, also located

within the grip volume of the hand, to provide direct angular position measurement for each axis of motion.

Previous designs either had the pivot axes located outside the grip envelope, or used mechanical linkages to couple the axes of motion to remotely located spring mechanisms and sensors. This proposed design is not susceptible to vibration, shock, or g-loading in any axis, is of the smallest possible size and weight, and is highly reliable.

*This work was done by Pablo Bandera and Paul Buchele of Honeywell, Inc. for Johnson Space Center. For further information, contact*

*the JSC Innovation Partnerships Office at (281) 483-3809.*

*Title to this invention has been waived under the provisions of the National Aeronautics and Space Act {42 U.S.C. 2457(f)} to Honeywell, Inc. Inquiries concerning licenses for its commercial development should be addressed to:*

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