Neuropsychological Testing of Astronauts

Lyndon B. Johnson Space Center, Houston, Texas

The Spaceflight Cognitive Assessment Tool for Windows (WinSCAT) is a computer program that administers a battery of five timed neuro-cognitive tests. WinSCAT was developed to give astronauts an objective and automated means of assessing their cognitive functioning during space flight, as compared with their own baseline performances measured during similar prior testing on the ground. WinSCAT is also intended for use by flight surgeons to assess cognitive impairment after exposure of astronauts to such cognitive assaults as head trauma, decompression sickness, and exposure to toxic gas. The tests were selected from among a group of tests, denoted the Automated Neuropsychological Assessment Metrics, that were created by the United States Navy and Army for use in evaluating the cognitive impairment of military personnel who have been subjected to medication or are suspected to have sustained brain injuries. These tests have been validated in a variety of clinical settings and are now in the public domain. The tests are presented in a Microsoft Windows shell that facilitates administration and enables immediate reporting of test scores in numerical and graphical forms.

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Refer to MSC-23332.

Method of Calibration for a Large Cathetometer System

This method costs considerably less than does a prior method

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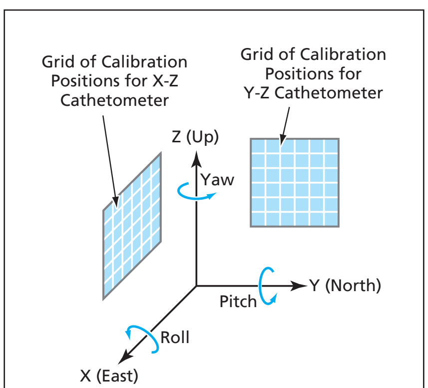
A method of calibration has been devised for a pair of mutually orthogonal two-axis cathetometers that, when used together, yield measurements of three-dimensional positions of objects mounted on an optical bench. Each cathetometer has a horizontal travel of 1.8 m and a vertical travel of 1.2 m. The cathetometers are required to measure *X*, *Y*, and *Z* coordinates (see figure) to within ±0.005 in. (±0.127 mm).

Each cathetometer consists of an alignment telescope on a platform mounted on a two-dimensional translation stage. The knowledge required for calibration of each cathetometer is (1) the two-dimensional position of the cathetometer platform as a function of the electronic readouts of position encoders on the translation stage and (2) the amount of any angular misalignment (roll, pitch, and/or yaw) of the cathetometer platform as a function of the two-dimensional coordinates or the position-encoder readouts. By use of three equations derived from the applicable trigonometric relationships, the calibrated *X*, *Y*, and *Z* coordinates can be computed from the raw encoder readouts.



***X, Y,* and *Z* Coordinates** are measured by combined use of an *X-Z* and *Y-Z* cathetometer.

The calibration measurements are performed by use of two main tools: a laser ranging interferometer and an electronic level that provides a gravity reference. The laser ranging interferometer is used to measure the yaw and roll of the *X-Z* cathetometer and the yaw and pitch of the *Y-Z* cathetometer. The laser ranging interferometer is also used to calibrate the position encoders. The electronic level gives a gravity reference for the interferometer measurements and for aligning the *Z* axis as close as possible to vertical. The interferometer is precise to within 0.01 arc seconds, and the level is precise to within 0.2 arc seconds. Once the calibration measurements have been completed and until a recalibration is required, it is not necessary to use the interferometer and level to monitor the cathetometers during operation.

The calibration measurements for each cathetometer are performed on a two-dimensional grid of positions at increments of 20 mm. For intermediate positions, angular-misalignment data and the uncertainties in those data are obtained by use of a bilinear interpolation scheme that is amenable to rapid calculation. The raw calibration measurement data are stored in text files in a computer. Software written specifically for the purpose performs the interpolation and the conversion of raw encoder outputs to calibrated *X*, *Y*, and *Z* coordinates in real time.

Tests have shown that the uncertainty in the calibration satisfies the ±0.005-in. (±0.127-mm) requirement. This is comparable to the uncertainties of laser trackers and theodolites.

A prior calibration method that affords the requisite accuracy is time-consuming, requires at least two technicians, and involves the use of custom-made scales and tooling bars in conjunction with constant monitoring of the cathetometers during operation by use of a displacement-measuring interferometer. In contrast, the present method can be implemented by a single technician, takes less time, and does not require constant use of an interferometer. The net result is that the present method costs several hundred thousand dollars less.

This work was done by Ronald Toland of **Goddard Space Flight Center**. *Further information is contained in a TSP (see page 1).*
GSC-14741-1