



Multi-axis, Lightweight, Computer-Controlled Exercise System

This system offers unprecedented versatility for physical conditioning and evaluation.

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The multipurpose, multi-axis, isokinetic dynamometer (MMID) is a computer-controlled system of exercise machinery that can serve as a means for quantitatively assessing a subject's muscle coordination, range of motion, strength, and overall physical condition with respect to a wide variety of forces, motions, and exercise regimens. The MMID is easily reconfigurable and compactly stowable and, in comparison with prior computer-controlled exercise systems, it weighs less, costs less, and offers more capabilities.

Whereas a typical prior isokinetic exercise machine is limited to operation in

only one plane, the MMID can operate along any path. In addition, the MMID is not limited to the isokinetic (constant-speed) mode of operation. The MMID provides for control and/or measurement of position, force, and/or speed of exertion in as many as six degrees of freedom simultaneously; hence, it can accommodate more complex, more nearly natural combinations of motions and, in so doing, offers greater capabilities for physical conditioning and evaluation.

The MMID (see figure) includes as many as eight active modules, each of which can be anchored to a floor, wall,

ceiling, or other fixed object. A cable is payed out from a reel in each module to a bar or other suitable object that is gripped and manipulated by the subject. The reel is driven by a DC brushless motor or other suitable electric motor via a gear reduction unit. The motor can be made to function as either a driver or an electromagnetic brake, depending on the required nature of the interaction with the subject. The module includes a force and a displacement sensor for real-time monitoring of the tension in and displacement of the cable, respectively. In response to commands from a control computer, the motor can be operated to generate a required tension in the cable, to displace the cable a required distance, or to reel the cable in or out at a required speed.

The computer can be programmed, either locally or via a remote terminal, to support exercises in one or more of the usual exercise modes (isometric, isokinetic, or isotonic) along complex, multi-axis trajectories. The motions of, and forces applied by, the subject can be monitored in real time and recorded for subsequent evaluation. Through suitable programming, the exercise can be adjusted in real time according to the physical condition of the subject. The remote-programming capability makes it possible to connect multiple exercise machines into a network for supervised exercise by multiple subjects or even for competition by geographically dispersed subjects.

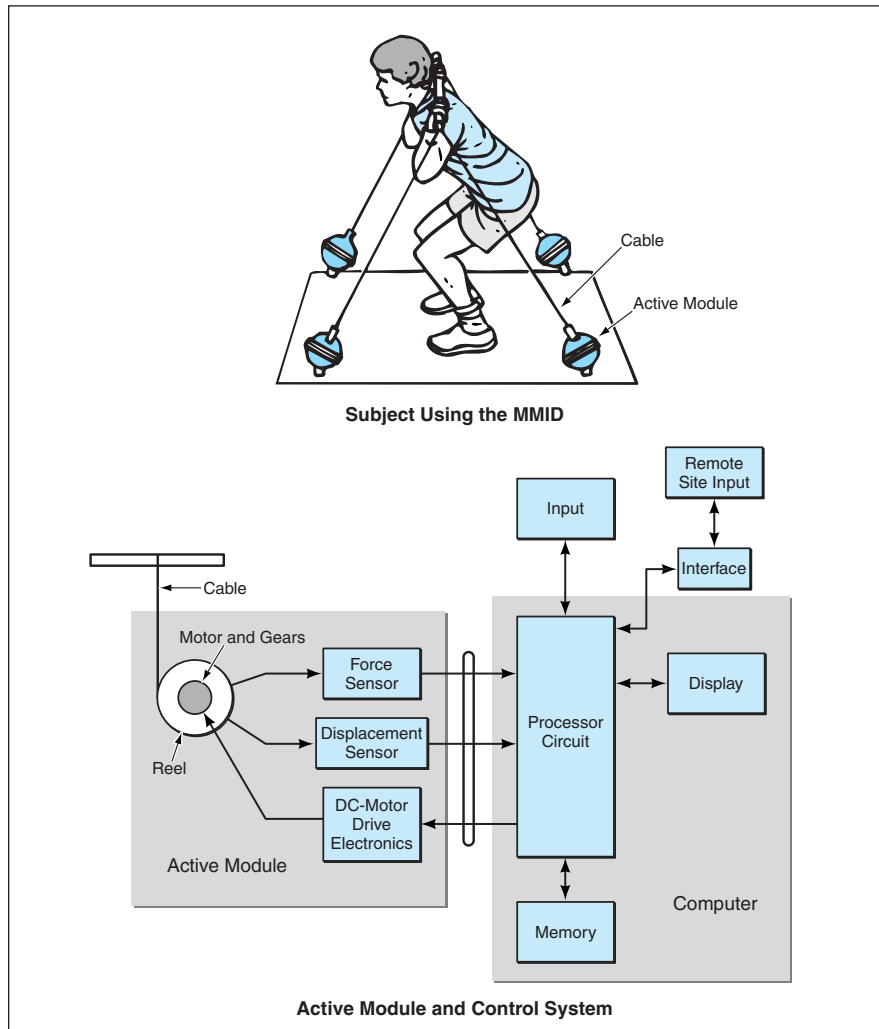
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In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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Refer to MSC-23353, volume and number of this NASA Tech Briefs issue, and the page number.



Computer-Controlled Active Modules pay out or retract cables at controlled tension, displacement, or speed.