Rehabilitation Tool

A MOVEMENT THERAPY DEVICE IS BASED ON SPACE SENSOR TECHNOLOGY

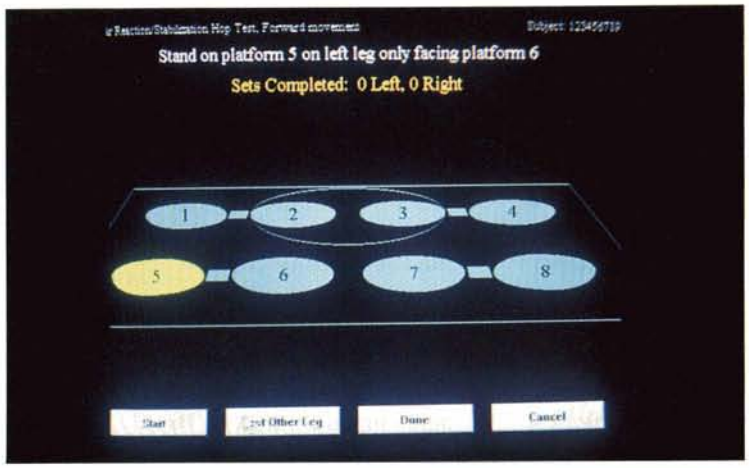
In the mid-1980s, martial arts expert Barry French developed a technique for measuring precisely the force of a karate kick or a boxer's punch and introduced to the market the Impax line of force measurement products, which are produced and sold by a company French formed, Impulse Sports Training Systems, Inc., Rocky River, Ohio. Impax products incorporate a piezoelectric film sensor similar to NASA-developed sensors that measure microscopic particle impacts in space. French's developments benefited from technical assistance provided by Lewis Research Center on such matters as sensors, materials and optimal structures.

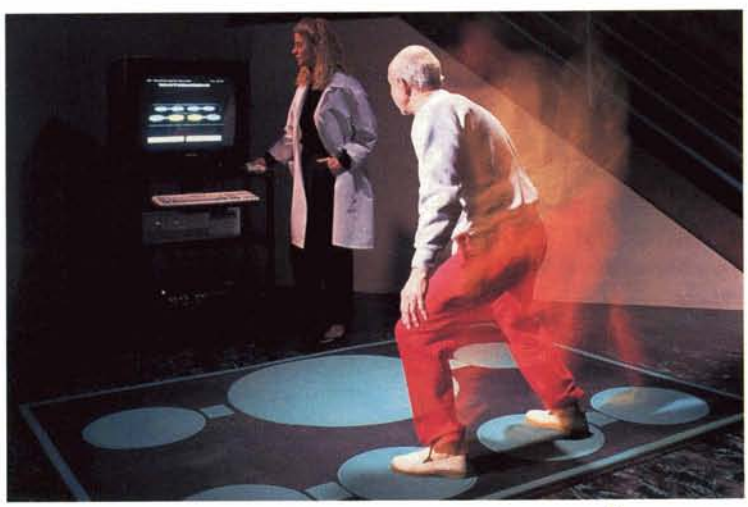
Building on those technologies and again benefiting from NASA assistance, French has formed Impulse Technology, Inc. to develop and bring to the marketplace a new force sensing system known as Biotran™. It is intended primarily to help physicians and physical therapists treat people with movement deficiencies, although it also has applications in sports training and evaluation.

A person's ability to initiate and coordinate weight-bearing movement may be compromised by injury, disease or any type of dysfunction that affects strength, balance, agility, or joint stability. Biotran serves as a post-injury or post-surgery tool of rehabilitative medicine. It provides a means of testing weight-bearing capabilities through direct measurement, but it does more than simply evaluate; it actively assists in the rehabilitation process, putting patients through a course of computer-directed exercises designed to improve strength and balance reaction time.

Biotran has been called an "intelligent floor." It is basically a set of 7-19 floor-based force sensing platforms linked to a personal computer. A color monitor cues the user through a series of exercises in a sort of interactive video game. It may, for example (as shown ***at left***), direct the user to "Stand on Platform 5 on left leg only facing Platform 6," then follow with a rapid series of instructions to follow a sequence of hops and steps to various platforms. As the user complies, the transducer platforms measure the impact force of his/her foot as it strikes the platform and the computer calculates such factors as reaction time, acceleration, deceleration, braking and foot speed.

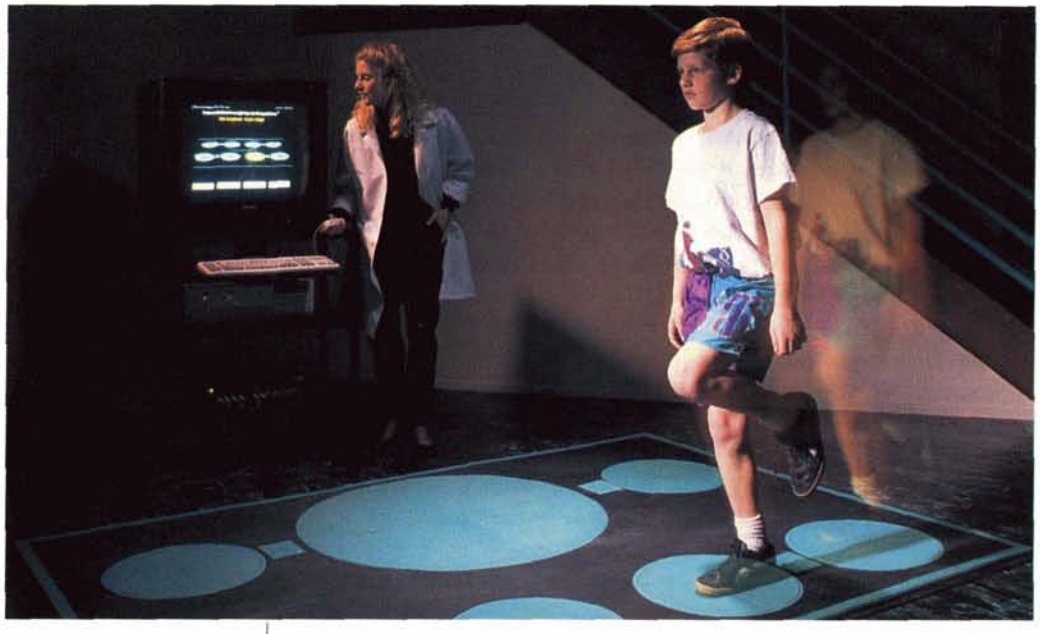
At left, a user is watching the screen for instructions as he plays a kind of computer-directed hopscotch, jumping from one platform to another as advised. ***At right top*** is a simulated weight-bearing test in which the user has been direct-

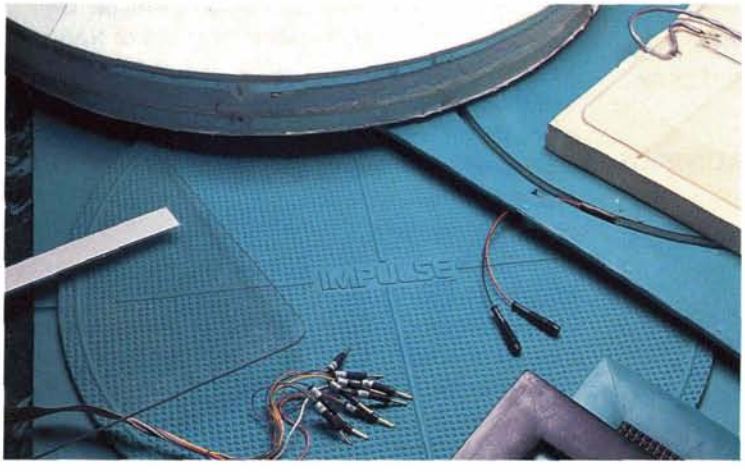




67

68





ed to hop in a straight line across a row of platforms on an affected limb; a base line test of the same moves on the unaffected limb provides a comparison. In these photos, the users are working with the smaller of three Biotran models; it has seven sensing platforms in a floor area measuring six by eight feet, along with a 26-inch monitor, a data acquisition module and the requisite software. A larger model has 19 platforms and a 10-foot screen, together with the module and software.

In rehabilitative medicine, Biotran identifies and quantifies a patient's functional weaknesses or limitations, then becomes the focal equipment of an exercise/training program designed to strengthen the patient's affected parts. The system provides a means of testing and documenting progress until maximal medical improvement is achieved.

The biggest technical challenge in developing Biotran, according to Barry French, was designing the deformable sensing platform. He credits NASA with a major assist, particularly in the matter of material selection. Impulse Technology wanted a low-cost, durable material that would conform to any type of floor, and, after consulting NASA technology transfer experts, selected a custom urethane. The ***lower left photo*** symbolizes the NASA/Impulse Technology collaboration in material investigations. A portion of the sensing platform is seen at the top of the picture; the band running around the perimeter of the disc is the piezoelectric sensing film. More than 500 different types of foam, plastic and rubber compositions were tested before the ultimate selection was made, and many different ways of attaching the sensor band to the platform were tried. The combination pictured is sensitive enough to measure the heartbeat of an adult standing barefoot through the soles of the feet. ●

™ Biotran is a trademark of Impulse Technology, Inc.