Bio-Medical

Fluorogenic Cell-Based Biosensors for Monitoring Microbes

Lyndon B. Johnson Space Center, Houston, Texas

Fluorogenic cell-based sensor systems for detecting microbes (especially pathogenic ones) and some toxins and allergens are undergoing development. These systems harness the natural signal-transduction and amplification cascades that occur in mast cells upon activation with antigens. These systems include (1) fluidic biochips for automated containment of samples, reagents, and wastes and (2) sensitive, compact fluorometers for monitoring the fluorescent responses of mast cells engineered to contain fluorescent dyes. It should be possible to observe responses within minutes of adding immune complexes. The systems have been shown to work when utilizing either immunoglobulin E (IgE) antibodies or traditionally generated rat antibodies — a promising result in that it indicates that the systems could be developed to detect many target microbes. Chimeric IgE antibodies and rat immunoglobulin G (IgG) antibodies could be genetically engineered for recognizing biological and chemical warfare agents and airborne and food-borne allergens. Genetic engineering efforts thus far have yielded (1) CD14 chimeric antibodies that recognize both Gram-positive and Gram-negative bacteria and bind to the surfaces of mast cells, eliciting a degranulation response and (2) rat IgG2a antibodies that act similarly in response to low levels of canine parvovirus.

This work was done by Theresa Curtis, Noe Salazar, Joel Tabb, and Chris Chase of Agave BioSystems for Johnson Space Center. For further information, contact the Johnson Commercial Technology Office at (281) 483-3809.

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Johnson Space Center, (281) 483-1003. Refer to MSC-23797-1.

A Constant-Force Resistive Exercise Unit

Lyndon B. Johnson Space Center, Houston, Texas

A constant-force resistive exercise unit (CFREU) has been invented for use in both normal gravitational and microgravitational environments. In comparison with a typical conventional exercise machine, this CFREU weighs less and is less bulky: Whereas weight plates and associated bulky supporting structures are used to generate resistive forces in typical conventional exercise machines, they are not used in this CFREU. Instead, resistive forces are generated in this CFREU by relatively compact, lightweight mechanisms based on constant-torque springs wound on drums. Each such mechanism is contained in a module, denoted a resistive pack, that includes a shaft for making a torque connection to a cable drum. During a stroke of resistive exercise, the cable is withdrawn from the cable drum against the torque exerted by the resistance pack.

The CFREU includes a housing, within which can be mounted one or more resistive pack(s). The CFREU also includes mechanisms for engaging any combination of (1) one or more resistive pack(s) and (2) one or more spring(s) within each resistive pack to obtain a desired level of resistance.

This work was done by Paul Colosky and Tara Ruttley of Valeo Human Systems, Inc., for Johnson Space Center.

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:

Valeo Human Systems, Inc.
3350 Eastbrook Dr., Ste. 109
Fort Collins, CO 80525

Refer to MSC-23373-1, volume and number of this NASA Tech Briefs *issue, and the page number.*

GUI To Facilitate Research on Biological Damage From Radiation

Lyndon B. Johnson Space Center, Houston, Texas

A graphical-user-interface (GUI) computer program has been developed to facilitate research on the damage caused by highly energetic particles and photons impinging on living organisms. The program brings together, into one computational workspace, computer codes that have been developed over the years, plus codes that will be developed during the foreseeable future, to address diverse aspects of radiation damage. These include codes that implement radiation-track models, codes for biophysical models of breakage of deoxyribonucleic acid (DNA) by radiation, pattern-recognition programs for extracting quantitative information from biological assays, and image-processing programs that aid visualization of DNA breaks.

The radiation-track models are based on transport models of interactions of radiation with matter and solution of the Boltzmann transport equation by use of both theoretical and numerical models. The biophysical models of breakage of DNA by radiation include biopolymer coarse-grained and atomistic models of DNA, stochastic-process models of deposition of energy, and Markov-based probabilistic models of placement of double-strand breaks in DNA. The program is designed for use in the NT, 95, 98, 2000, ME, and XP variants of the Windows operating system.

This program was written by Frances A. Cucinotta of Johnson Space Center and Artem Lvovich Ponomarev of Universities Space Research Association. Further information is contained in a TSP (see page 1).

Universities Space Research Association has requested permission to assert copyright for the software code. MSC-23853-1

On-Demand Urine Analyzer

John H. Glenn Research Center, Cleveland, Ohio

A lab-on-a-chip was developed that is capable of extracting biochemical indicators from urine samples and generating their surface-enhanced Raman spectra (SERS) so that the indicators can be quantified and identified. The development was motivated by the need to monitor and assess the effects of extended weightlessness, which include space motion sickness and loss of bone and muscle mass. The results may lead to developments of effective exercise programs and drug regimes that would maintain astronaut health.

The analyzer containing the lab-on-a-chip includes materials to extract 3-methylhistidine (a muscle-loss indicator) and Risedronate (a bone-loss indicator) from the urine sample and detect them at the required concentrations using a Raman analyzer. The lab-on-a-chip has both an extractive material and a SERS-active material. The analyzer could be used to monitor the onset of diseases, such as osteoporosis.

This work was done by Stuart Farquharson, Frank Inscore, and Chetan Shende of Real-Time Analyzers, Inc. for Glenn Research Center. 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-18258-1.

More-Realistic Digital Modeling of a Human Body

Lyndon B. Johnson Space Center, Houston, Texas

A MATLAB computer program has been written to enable improved (relative to an older program) modeling of a human body for purposes of designing space suits and other hardware with which an astronaut must interact. The older program implements a kinematic model based on traditional anthropometric measurements that do provide important volume and surface information. The present program generates a three-dimensional (3D) whole-body model from 3D body-scan data. The program utilizes thin-plate spline theory to reposition the model without need for additional scans.

This program was written by Renee Rogge of Mercer University for Johnson Space Center. For further information, contact the Johnson Commercial Technology Office at (281) 483-3809. MSC-24040-1

Advanced Liquid-Cooling Garment Using Highly Thermally Conductive Sheets

This garment provides metabolic heat rejection applicable to surgical cooling vests, combat fatigues, and firefighter and hazmat suits.

Lyndon B. Johnson Space Center, Houston, Texas

This design of the liquid-cooling garment for NASA spacesuits allows the suit to remove metabolic heat from the human body more effectively, thereby increasing comfort and performance while reducing system mass. The garment is also more flexible, with fewer restrictions on body motion, and more effectively transfers thermal energy from the crewmember's body to the external cooling unit. This improves the garment's performance in terms of the maximum environment temperature in which it can keep a crewmember comfortable.

The garment uses flexible, highly thermally conductive sheet material (such as graphite), coupled with cooling water lines of improved thermal conductivity to transfer the thermal energy from the body to the liquid cooling lines more effectively. The conductive sheets can be layered differently, depending upon the heat loads, in order to provide flexibility, exceptional in-plane heat transfer, and good through-plane heat transfer. A metal foil, most likely aluminum, can be put between the graphite sheets and the external heat source/sink in order to both maximize through-plane heat transfer at the con-