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.

**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.

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**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**

*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-