stead, the attached, rounded morphology, coupled with the high degree and duration of cell-to-cell contact, is thought to induce expression of genes that causes the cells to switch from proliferating to differentiating phenotype. This differentiating phenotype gains the ability to fuse and express contractile proteins.

Currently, this model can serve as an improved, yet easily generated, in vitro skeletal muscle test bed for evaluating signal transduction pathways, stretch activated ion channels, protein synthesis regulation, and interactions with the extracellular matrix and membrane proteins with the cytoskeleton. The ease and low cost of generation makes this model a valuable option to many laboratories that have the desire, but lack the sophisticated resources previously required to explore the mechanisms of muscle atrophy. Future development of the model into a three-dimensional construct provides a potential powerful tool for defining the mechanisms of microgravity-induced muscle atrophy, identification of molecular targets for novel countermeasure development, and testing of some countermeasures.

This work was done by Michele L. Marquette of the University of Texas Medical Branch, and Marguerite A. Sognier of the Universities Space Research Association for Johnson Space Center. For further information, contact the JSC Innovation Partnerships 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-24314-1

Hand-Based Biometric Analysis

Goddard Space Flight Center, Greenbelt, Maryland

Hand-based biometric analysis systems and techniques provide robust hand-based identification and verification. An image of a hand is obtained, which is then segmented into a palm region and separate finger regions. Acquisition of the image is performed without requiring particular orientation or placement restrictions. Segmentation is performed without the use of reference points on the images. Each segment is analyzed by calculating a set of Zernike moment descriptors for the segment.

The feature parameters thus obtained are then fused and compared to stored sets of descriptors in enrollment templates to arrive at an identity decision. By using Zernike moments, and through additional manipulation, the biometric analysis is invariant to rotation, scale, or translation or an input image. Additionally, the analysis uses re-use of commonly seen terms in Zernike calculations to achieve additional efficiencies over traditional Zernike moment calculation.

This work was done by George Bebis of University of Nevada, Reno for Goddard Space Flight Center. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810. GSC-16141-1

The Next Generation of Cold Immersion Dry Suit Design Evolution for Hypothermia Prevention

The system design recovers warm exhaled air and re-circulates it inside the suit.

John H. Glenn Research Center, Cleveland, Ohio

A body at sea is vulnerable to hypothermia, which often leads to loss of life. Hypothermia is caused by the differences between the core body temperature and the surrounding air and seawater temperatures. The greater the differences between the body core temperature and the sea temperature, the more rapidly the core body temperature will drop, and hypothermia can quickly set in. Heat loss is primarily caused by conduction of heat away from the body. Most cold immersion suits on the market are passive designs that only insulate the body against the cold, although some cold immersion suits use special materials such as paraffin to absorb heat and to radiate the heat back to the body. This new utility patent is an active design that relies on the lung's role as an organic heat exchanger for providing deep body core heating of air. It is based on the fact that the greatest heat loss mechanism for an insulated human body immersed in a cold water environment is due to heat loss through respiration.

This innovation successfully merges two existing technologies (cold immersion suit and existing valve technologies) to produce a new product that helps prevent against the onset of hypothermia at sea. During normal operations, a human maintains an approximate body temperature of [98.6 °F (37 °C)]. A mechanism was developed to recover the warm temperature from the body and reticulate it in a survival suit. The primary intention is to develop an encompassing systems design that can both easily and cost effectively be integrated in all existing currently manufactured cold water survival suits, and as such, it should be noted that the cold water immersion suit is only used as a framework or tool for laying out the required design elements.

At the heart of the suit is the Warm Air Recovery (WAR) system, which relies on a single, large Main Purge Valve (MPV) and secondary Purge Valves (PV) to operate. The main purge valve has a thin membrane, which is normally closed, and acts as a one-way check valve. When warm air is expelled from the lungs, it causes the main purge valve to open. Air forced from the MPV is dumped directly into the suit, thereby providing warmth to the torso, legs, and arms. A slight positive over-pressure in the suit causes warm waste air (or water if the suit is punctured) to be safely vented into the sea through large PVs located at the bottom of each arm and leg. The secondary purge valves act to prevent the buildup of large concentrations of CO_2 gas and help guard against asphyxia. It is noted that the MPV causes the inhalation and exhalation cycles to be completely isolated from one another in the current suit design.

The main problem with the existing survival suit designs stems from cold sea water entering the suit through the gaps around the face opening in the hood and inflatable neck collar. Cold water entering the suit is caused by high wind and waves, a problem that is further exacerbated if the suit is submerged by a wave. The problem is easily solved using four integral components: an optically transparent full face shield, a nose/mouth mask, a Surface Air Valve (SAV), and a MPV.

Surface air valve integration with the suit is effected by affixing the SAV on the outward side of the face shield with a short tube extending through the face shield, which is directly plumbed to the air inlet port on the mask. WAR system integration with the suit is achieved by connecting the MPV to the air outlet port located at the bottom of the mask near the mouth.

A special type of SAV mechanism called a Pressure Release Valve (PRV) is employed in the current design. When the PRV is above the sea surface, the PRV is open, allowing the lungs to inhale a fresh atmospheric air. The PRV automatically closes when submerged. This PRV has the advantage of being able to operate in any position, even while completely submerged upside down. The PRV is connected to a short tube extending through the face shield, and the open end of the tube is terminated with yet another purge valve located at the air inlet port on the mask. The PRV and PV combo results in a unique new type of valve called a Pressure Release/Purge valve (PR/P) that is designed to compensate for additional heat loss from the respiration cycle and only applies to situations when the PR/P valve is above the sea surface. The following two examples are cosidered:

Example (1) is a situation in which the air inlet port on the mask is connected to the PRV by a short tube extending through the face shield. Since the PRV is above the sea surface, the PRV is open and air can freely be drawn into the lungs. When warm air is exhaled from the lungs, it causes air to flow outward through the PRV, causing the body to lose valuable heat during the exhalation cycle. Therefore, in this example, the inhalation and exhalation cycles are no longer separated from one another.

Example (2) is a situation in which the PR/P valve on the face shield is connected to the air inlet port on the mask, and the MPV is connected to the air outlet port on the mask. Because the PR/P valve is above the sea surface, the PR/P valve is open. The action of drawing air from the mask causes the PV located at the end of the PR/P valve to open and the MPV to close. When air is exhaled from the lungs into the mask, it causes the PV located on the end of the PR/P valve to close, and warm exhaled air flowing into the mask forces the MPV to open, venting warm air directly into the suit. Thus the PR/P valve recovers any heat loss during the exhalation part of the respiration cycle.

The new technology represents a substantial improvement over existing state-of-the-art survival suit designs and should greatly extend the length of time a body can survive in hazardous cold-water conditions encountered in the North Atlantic, Bering Sea, and other cold regions of the world. This suit technology is intended to be utilized by the various branches of the U.S. Coast Guard, the U.S. Navy, the Merchant Marine, as well as the commercial fishing industry fleet.

This work was done by Joel Galofaro of 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: Steven Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18960-1.