Space Suit Research in North Dakota

It Began with Space Grant

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Sponsored by the North Dakota Space Grant Consortium
UND (2004)

• Incorporate a human spaceflight component to the Department of Space Studies

Develop NASA relevant space suit research in the state

Develop projects with a hand-on element for UND Space Studies graduate students

Create ties with commercial spaceflight companies
NDX-1
(North Dakota Experimental Space Suit)
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(North Dakota Experimental Space Suit)

Colleges and Universities involved:

The University of North Dakota
Lead Institution, Design, Integration

North Dakota State University
Biomedical sensors, Temperature, Humidity, Heart rate, Respiration

Turtle Mountain Community College
Software design, Computer integration

Dickinson State University
Test site preparation, Field testing, Performance evaluation, Logistics

North Dakota State College of Science
Precision machining, Closing systems, Mechanical integration
NDX-1
(North Dakota Experimental Space Suit)
TESTING PHASE
Thermal and Dust Garment
TESTING PHASE

Thermal-Dust Garment and Simulated Backpack
TESTING PHASE

- Exercise Loads on Suited and Unsuited Test Subject
NDX-1 at the MDRS
NDX-1 at the MDRS
NDX-1 at the MDRS
SPACECRAFT SIMULATOR
SPACECRAFT SIMULATOR
SPACESHIP ONE
SPACESHIP ONE SIMULATOR
SPACESHIP ONE
SIMULATOR

Cirrus Aviation Corp.
SPACESHIP ONE SIMULATOR
SPACESHIP ONE SIMULATOR
SPACESHIP ONE SIMULATOR
SPACESHIP ONE SIMULATOR
UND HUMAN SPACEFLIGHT LABORATORY

Created in 2005
Part of Department of Space Studies
Funded by NASA through ND Space Grant Consortium and other grants.
UND SPACE SUIT LABORATORY
UND SPACE SUIT LABORATORY
NDX-2 Lunar Suit Prototype
UND SPACE SUIT LABORATORY

NDX-2
NDX-2 Lunar Suit

- SUT will utilize a back-entry hatch that will interface to an airlock/suitport hatch.

- The portable life support system (PLSS) elements will be included within the suit’s pressurized volume.

- Back-entry hatch rings, closure mechanisms and seals, and interface rings are being machined by students at NDSCS so as to provide experience regarding space-qualified tolerances.

- Once again NDSU is developing the Biomedical Data Package for the NDX-2, being an upgrade of the system used in the NDX-1.
NDX-2 Lunar Suit Prototype
NDX-2
Suit-Port Concept
NDX-2
NDX-2
NASA EPSCoR CAN Grant

Integrated Strategies for the Human Exploration of the Moon and Mars
NASA Grant

The research goals of this three-year project are to:

Demonstrate the practicality of deriving the structure and interfaces of the suit-airlock-habitat-rover and shelter from a common technological base.

Develop and describe the inflatable-rigid frame concept further based on parallel space suit research efforts and evolving NASA requirements and establish the technical feasibility of this approach.

Demonstrate the usability of the suit-port concept for pressurized rover/pressurized habitat operations.
Field deploy and test these elements and systems in the North Dakota Badlands, with the presence and input of NASA personnel; and

When complete, the equipment and tools will be offered to NASA for use in future research. The habitat elements will be able to be broken down and redeployed in other locations.
Inflatable Habitat Concept
Integrated Strategies for the Exploration of the Moon and Mars

Notional Concept Illustration for Habitat Architecture
University of North Dakota Department of Space Studies
1 October 2009
The Project

Conjugal Joint
Maries bladder to frame and allows structural loads to pass through bladder without penetration

Hub Connector

Tubular Strut

External Attachment Hardpoint

Bladder

Enlarged view of Conjugal Joint
This joint allows the pressure bladder to be structurally connected to the rigid frame without penetration of the bladder.
Inflatable Habitat Concept
Inflatable Habitat Concept
Integrated Strategies for the Exploration of the Moon and Mars

Notional Concept Illustration for Habitat Architecture Combination via Airlock

University of North Dakota Department of Space Studies
1 October 2009
Rover Design
Rover Design
Rover Design
Rover Design
Opportunities for Students

- This project includes a total of twelve graduate students and eighteen undergraduate students in the process of conceptualization, design, construction, and testing that will result in a workforce that is well educated for the challenges ahead.
Continuing Research with NDX-1
Future

NASA Roses Moon and Mars Analog Mission Activities (MMAMA).

Nurture collaboration with other NASA Centers.

Continue educating the next generation of Human Spaceflight engineers and scientists.

Create programs and educational materials for elementary and high school students using the existing capabilities developed in the state.
Where are our graduates now?
Acknowledgements
Thank you for your attention!