MARS COUTURE

Today's spacesuits are disappointingly similar to those the Apollo astronauts wore four decades ago, but MIT aerospace engineer Dava Newman is looking to shake things up. Her prototype BioSuit, designed for future planetary exploration missions, clings to the skin like a leotard to allow for greater freedom of movement.

Equipped with an ample oxygen supply and state-of-the-art life-support sensors, the suit is designed to allow wearers to remain outside a spaceship for days or weeks at a time. Much like a future soldier's uniforms, the BioSuit will be outfitted with an array of communications equipment, chemical sensors, and wearable computers—the customisation possibilities are endless.

Elizabeth Svodoba spoke to Professor Newman about her suit:

Q: What are the advantages of a BioSuit over a traditional spacesuit?
A: Conventional spacesuits are massive, heavy, and offer very limited mobility. When you're wearing the BioSuit, you can't quite run, but you can do kind of a skip, not the two-footed bunny hop the Apollo astronauts did. Also, if you're in a conventional suit and it gets punctured, that's a real emergency situation. You only have seconds to minutes to get into a safe haven. If the BioSuit tears through, it can withstand a small hole—about a millimetre by a millimetre wide—and then you just need to wrap a piece of fabric over it like a Band-Aid. We know the suit can withstand these small breaches, which is a huge advantage in terms of safety.

Q: What inspired the BioSuit's design?
A: Paul Webb with the Air Force was one of the first to come up with a skin-tight suit in the 1960s—it was a great idea before its time. Webb's team had real trouble donning and doffing, putting the spacesuit on and taking it off. Now our design plan relies on advanced materials like shape-memory polymers. Imagine a leg-shaped cylinder that could fit over your calf, and if you heat it to a certain transition temperature, it becomes more pliable and cinches up around your leg. So it's very flexible in one state, and in another state, it's more rigid and has an increased diameter. That's going to be helpful in letting astronauts get in and out of the suits easily.

Q: Are there unique engineering challenges in creating a spacesuit that adheres to the skin?
A: With any kind of spacesuit, you have to create constant pressure inside in order to keep the person alive—the torso, the arms, the legs, the gloves all have to be at the same pressure. That's easy with a traditional gas-pressurized shell suit, because you're basically blowing up a balloon with the person inside. But something that actually adheres to the skin has to create customized mechanical pressure, squeezing the body differently in different places. We do 3-D laser scans of each human subject to look at how their skin moves and bends. That helps us figure out what design strategies are necessary to provide suit wearers with full locomotive capabilities while keeping the pressure at a constant level.
Moving joints definitely affect our designs. Around the front of your knee, the suit needs to be able to stretch by about 40%, and around the back, it needs to be able to contract by about 30%. The challenge is keeping the pressure inside the suit constant while the person's walking, climbing, and moving around.

Spacesuits through the years (left to right): Project Mercury late 1950's, Apollo moon landing (late 1960's), ISS space walk 2002, Biosuit 2005

Q: How can you be sure the suit will work properly in a space environment?
A: Rtight now we're developing prototype leg sleeves in the lab and testing them. First, we measure the pressure all around the circumference of the leg with paper-thin pressure sensors. We put these sensors underneath the garment, put the garment on a subject, and then put their leg in a chamber that simulates pressure conditions in space. This way, we can get accurate measurements of how much pressure the suit would actually be applying to the skin during a spacewalk.

Q: What new characteristics and materials are you considering incorporating into future suit prototypes?
A: The ultimate dream is a suit that knows exactly what the outside pressure is and is able to self-adjust—it knows what stress it should be applying, and can cinch itself up or loosen whenever that's appropriate, in real time. There are materials out there that have those properties, but a lot of these advanced materials aren't at the human scale yet; they can only be made in ant-sized quantities. We need something we can use to make 2 meters of fabric.
Also, when you're standing on Mars, the temperature can change 20 degrees Fahrenheit between your feet and your head—quite a differential. We're trying to make sure the suit wearer has active control over temperature in different regions of the body. We have the technology to do that with thermal sensors, and we could weave those into the suit as metallic threads.

Q: How do you envision the BioSuit fitting into the big picture of an exploration mission to the moon, Mars, or another planet?
A: The humans wearing the suit will be doing value-adding activities, like making real-time decisions, using their eyes, and all the important things their brains can help them do in a split second. But they'll also have robotic assistants, which are good at things like collecting data samples very fast, getting computers to analyse them, or doing repetitive tasks that really bore humans. A wheeled vehicle will be important as well. It's amazing how much more scientific return you get when a mission has a rover—you can cover kilometres of space rather than metres.

Q: Do you ever dream about embarking on an extraterrestrial mission yourself?
A: Right now, I'm just happy doing the research and working on the design concepts. Given the opportunity to go today, I'd jump at it, but the suit may not be ready until 20 years from now. If NASA's serious about sending people to the moon in 2018, they're going to have to make a real commitment to new suit capabilities 10 to 15 years before, which is just about where we are today. My real goal is working with NASA for the next couple of decades to make sure this suit happens.

ENDS 1080 WDS
Written by Elizabeth Svodoba

FULL PICTURE SET

For captions and credits, please refer to the captions.txt file


H414136.jpg


h414137.jpg

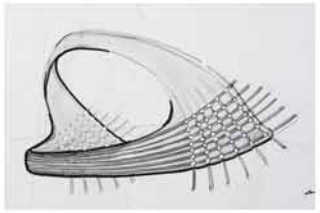

s300006.jpg

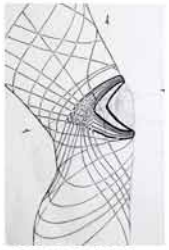

s300007.jpg


s300008.jpg


s300009.jpg


s300010.jpg


s300011.jpg


s300012.jpg


s300013.jpg


S320035.jpg


S380211.jpg


S565091.jpg