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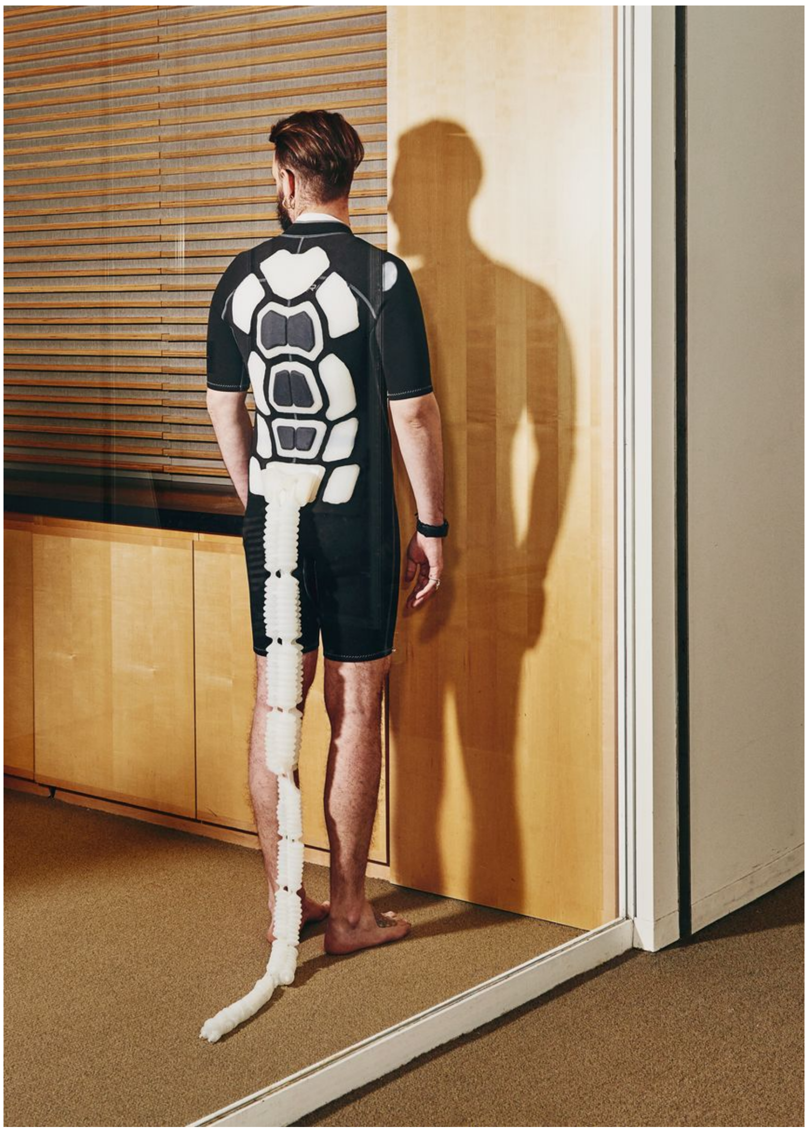
How a Robotic Tail Could Help Future Space Travelers

Researchers at the MIT Media Lab are developing technology for a day when amateur astronauts travel into orbit



Manuel Muccillo, a product designer, models a prototype of a robotic tail that would allow the wearer to grab objects, anchor to surfaces and balance while floating in reduce gravity environments. PHOTO: TONY LUONG FOR THE WALL STREET JOURNAL

By Leigh Kamping-Carder

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Astronauts train for life in microgravity, where small movements create momentum and stasis requires handholds and tethers. The concepts of "floor" and "ceiling" cease to be meaningful. As the day approaches when extra-planetary travel becomes more accessible (at least, initially, to billionaire space tourists), researchers are developing tools to ease the transition to weightless living.

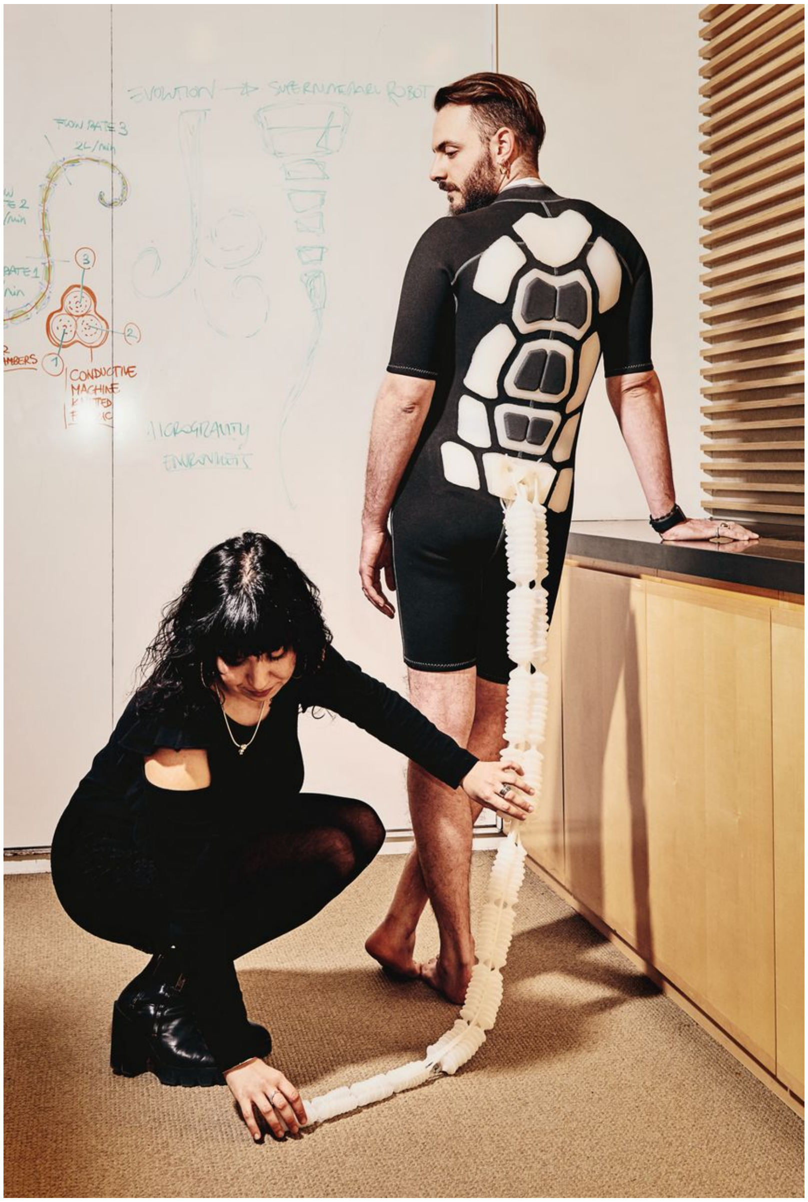
Valentina Sumini, a postdoctoral associate at the MIT Media Lab, and Manuel Muccillo, a product designer, are building a robotic tail called SpaceHuman. The idea is to help the casual space traveler grab objects, anchor to surfaces and balance while floating in environments with reduced gravity, like in a spacecraft or on the surface of Mars.

Dr. Sumini is a member of the Media Lab's Space Exploration Initiative, a group of 50 graduate students, faculty and staff developing technologies, tools and experiences for a new space age. In May, the group plans to test the tail and other projects on a microgravity flight. An airplane will take them up, then fly sharply down, allowing for 20 to 30 seconds of weightlessness at a time—a follow-up to a similar test in November 2017.

Inspired by seahorses, Dr. Sumini and Mr. Muccillo began designing the tail this past summer. The prototype consists of a trio of ribbed tubes made of translucent, flexible silicone. The ribs are actually 36 air chambers that can be inflated in different configurations by 12 battery-operated air pumps attached to a belt, causing the tail to curve or lengthen.

The tail responds to the wearer's environment and movements, grabbing onto surfaces, acting like a rudder during jumps or picking up objects as needed, thanks to an array of sensors on the tail and body and an object-tracking camera on the back. The camera uses an algorithm to identify colors and materials that have been uploaded to the system—brightly colored fabric for the microgravity test flight, but eventually handles and other items—and to respond accordingly, based on the object, distance and body position. "Our body is the main control tool," Dr. Sumini says.

In the meantime, Dr. Sumini is testing the prototype underwater. It's currently attached to a wet suit; eventually, the tail could be stuck to any piece of clothing with Velcro, she said. And it could have earthbound applications as a balancing device for first responders in disaster zones or an exoskeleton for construction or auto factory workers—anywhere people need an extra hand.

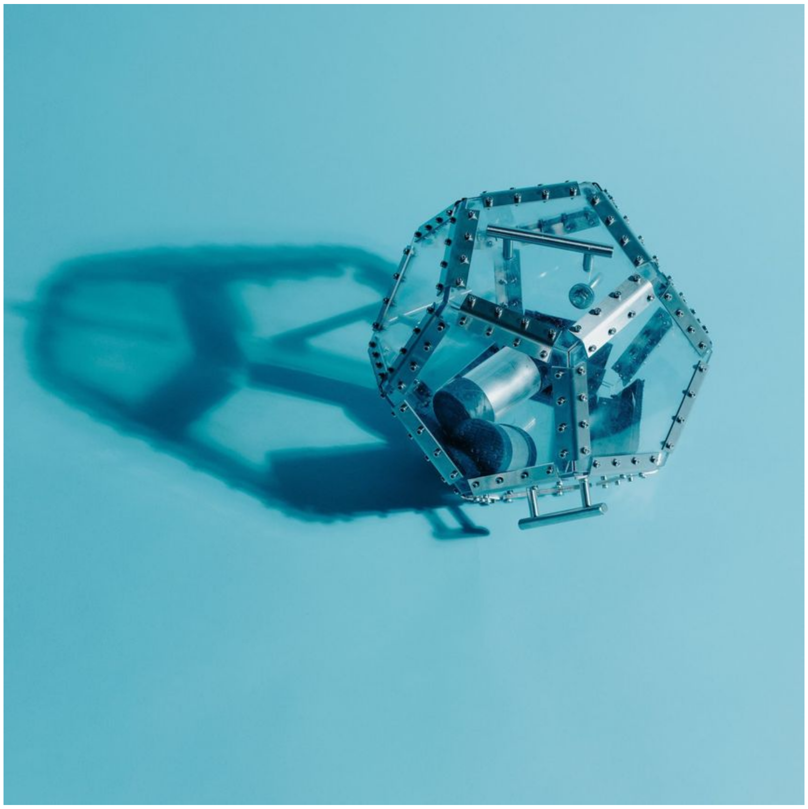


Inspired by seahorses, Valentina Sumini and Mr. Muccillo began designing the SpaceHuman robotic tail this past summer. Dr. Sumini plans to test it on a microgravity flight in May. PHOTO: TONY LUONG FOR THE WALL STREET JOURNAL

The Zero-Gravity Orchestra

Pianos don't work in zero gravity. But if we ever plan to spend extended periods in space, whether as orbital tourists, in lunar colonies or on missions to Mars, we may want to make a little music. Nicole L'Huillier, a MIT Media Lab research assistant, and Sands Fish, a designer and computer scientist, are building a zero-gravity orchestra—a series of instruments that rely on the suspension of gravity to play.

Their first attempt was the Telemetron, a clear, 12-sided polycarbonate chamber about the size of a soccer ball, which they tested on a microgravity flight with the MIT Media Lab Space Exploration Initiative in November 2017. Inside, there were three cylindrical chimes outfitted with gyroscopes and sensors that tracked their spins, collisions and drifts. That data was beamed to a computer, which translated each action into a musical note and played the resulting composition, at once dreamy and robotic.



The Telemetron. **PHOTO:** ALLY SCHMALING

Now, they're designing three more instruments: the Núcleo, a sphere with eight smaller spheres attached by springs; the Monolito, a 2-foot-long trapezoid; and the Satélite, made of five rotating bars that resemble the solar panels on a satellite.

Each instrument will be equipped with an inertial measurement unit—like a more sophisticated gyroscope—that will record speed, rotation and movement. Mr. Fish and Ms. L'Huillier have yet to finalize the sounds the instruments will make, but one might have a percussive effect, while another might sound more like a synthesizer. With their first instrument, slower motion produced quiet, low notes, while fast spins created a crescendo of loud, high notes. The next three will likely work the same way.

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Floating through space, the instruments can perform by themselves, or an astronaut could move them—a musical performance that's more choreography than composition. "Life in outer space is an entirely new environment," Mr. Fish says, "and entirely new forms of culture are going to emerge from that."