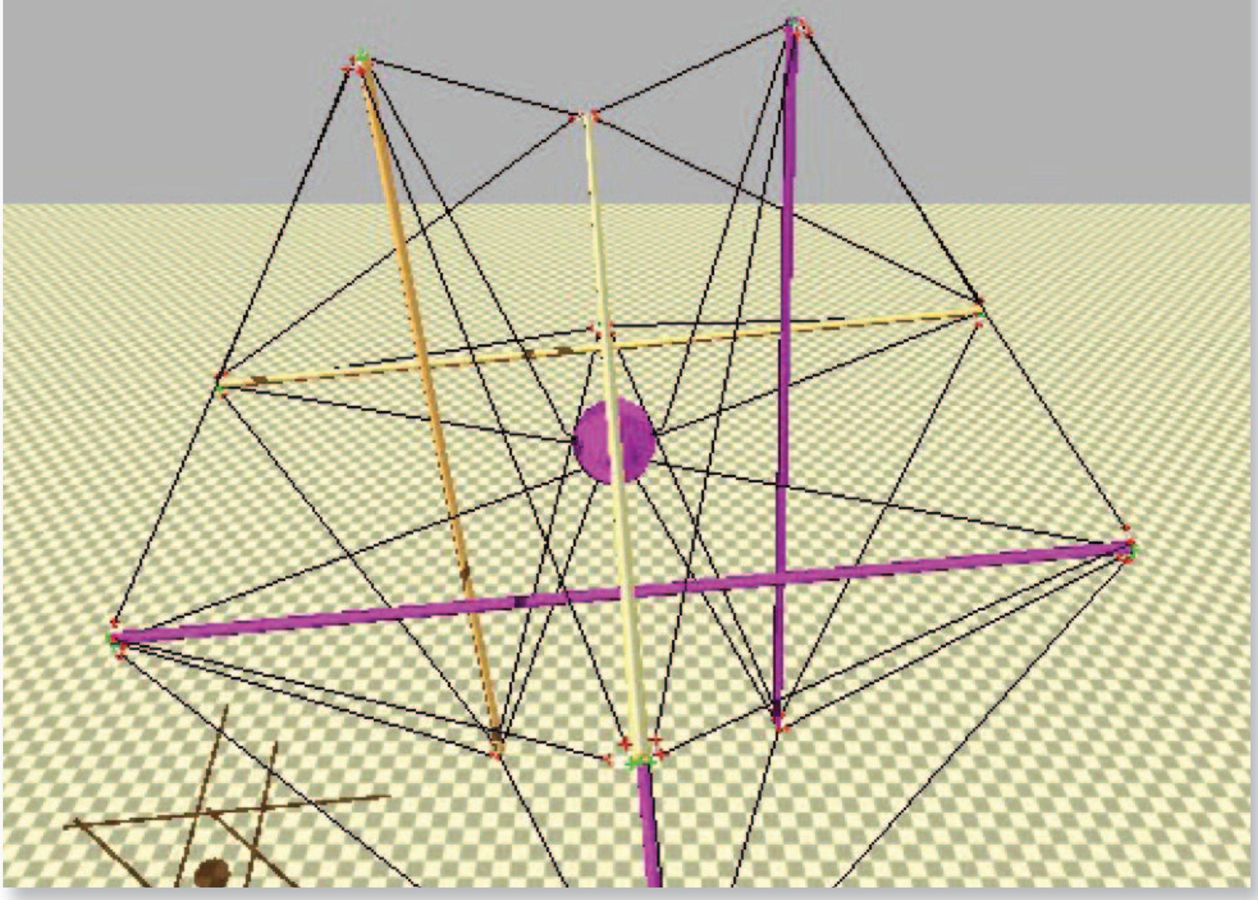


Graphics courtesy of Matt Menze and Vytas SunSpiral

NEXT-GEN SPACE ROBOTS

By Rebecca Tavernini '11 MA

Working at NASA seems a dream as unreachable as vacationing to other galaxies, but for Matthew Menze, a junior at NMU, it couldn't be more real, or more cool. He spent the fall semester as an intern at the National Aeronautics and Space Administration's Ames Intelligent Robotics Group in Mountain View, Calif.

"Growing up I have always taken in everything related to space with a sense of awe; endless sci-fi books have embedded in my head this idea that space is the ultimate goal of humanity," he says. "However, it wasn't until I had this opportunity that I truly understood the positive impact space research and exploration has had on social and technological advancement."

NMU junior Matthew Menze's I.D. photo from his NASA internship

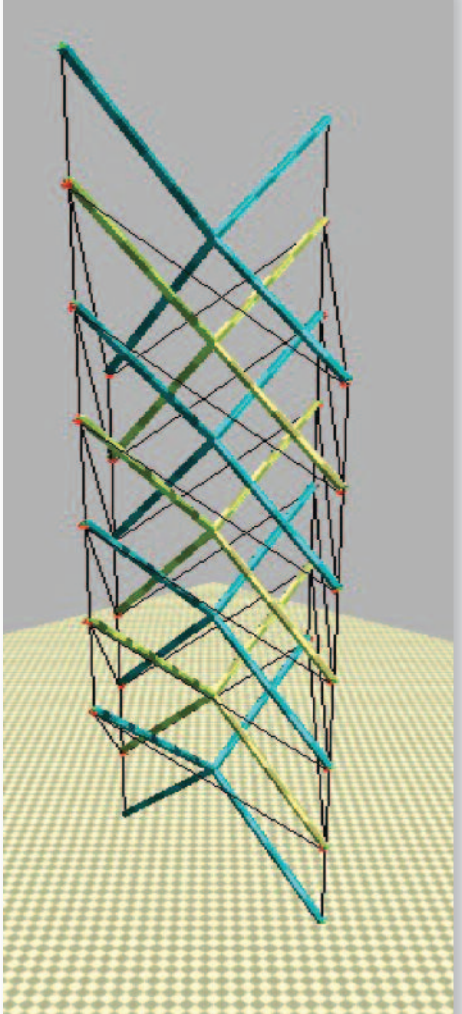
His work in the Intelligent Robotics Group focused on the technical side of that. As Menze explains it, "The IRG is a research-oriented group that works to explore and test theoretical concepts that are being proposed for future missions. The idea is that the information gained from experimenting with methods of accomplishing a given mission profile will allow future missions to be designed based on previous experience, rather than attempting to execute it purely on theoretical concepts. By the time any NASA mission is flown, it has been iterated through numerous incarnations and design phases."

Menze's mission at NASA was contributing to a team effort of laying the groundwork for a novel concept that may lead to a more nimble form of robots and exploratory vehicles, by incorporating tensegrity design principles. "Tensegrities are structures that are composed of rigid elements (rods) connected by a network of tension elements (cables) in such a way that all of the rods experience pure compressive forces, while all of the cables experience stress only from tension," says Menze. It may more easily be thought of in terms of human anatomy, where the rods are bones, and cables are muscles and ligaments.

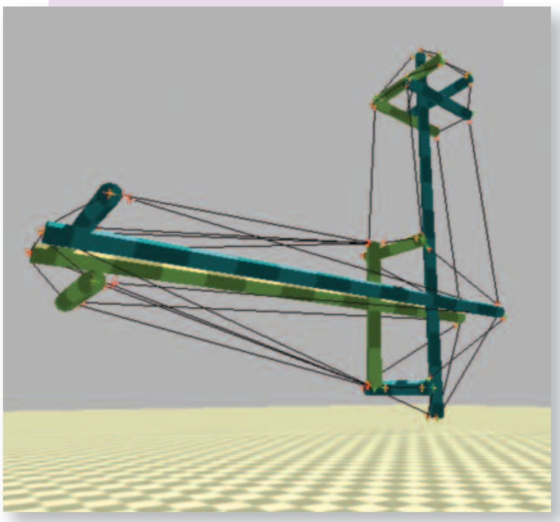
On his blog (www.magicalrobot.org), Menze's mentor at NASA, Vytas SunSpiral, explains "the inspiration for this research comes from the idea of 'Biotensegrity' pioneered by Dr. Steven Levin, which holds that tensegrity structures are a good model for how forces move through our bodies. Thus, instead of the common sense 'bone-centric' model where force passes comprehensively from bone to bone, one should take a fascia-centric view that looks at the global fascia network (i.e. continuous chains of muscles and ligaments) as the primary load paths in the body…they have many qualities which make them well suited for motion, especially the type of motion required of a robot (or animal) moving in the real world outside the safety of factories or laboratories."

Menze says, "While biological examples exist of tensegrities in animal physiology, little is known about controlling these non-linear structures from a robotics standpoint."

Menze, a dual major in computer science and electronics engineering, worked on building up a catalog of models to be used with a computer-generated transegrity simulator—structures of varying shapes, rod and cable lengths, points and tensions. He also worked with another team member to assist with the development of a tool set aiding researchers to more quickly and easily create and simulate these models. From there, engineers and programmers can build actual, functioning models to test in the real world.



Menze helped develop tools in a simulator to construct complex transegrity structures using only a few key parameters. The structure above resembles the forces and movements of a spine-like model. The pink ball on the opposite page represents a payload added to explore the effect of added mass. Below, the "ligaments" of an arm and elbow-like model may provide keys, as the others do as well, for constructing robotics that can better handle impacts, motion and varying terrains. These computational models are inspired by physical prototype models made by artist and inventor Tom Flemons.



While this work at one of the world's most venerated institutions may have serious implications, Menze, a Marquette native, was surprised by the fun work environment, which is a hallmark of Silicon Valley creativity. "It's completely orientated around maximizing project progress while still managing to be one of the most laid-back and low-stress work settings. There is also a huge emphasis on expanding your own horizons. NASA is constantly putting on seminars with experts from Ames, as well as guests from such organizations as Google and the Department of Defense.

"I really cannot say enough about how positive an experience Vytas created for me. He and everyone I was able to work with are doing an amazing job. Going to NASA, and Silicon Valley in general, was like stepping a few years into the future. Honestly, the most challenging thing I found about being there was just trying to live up to the level of the people around me."

Menze saw a microcosm of Earth's population, with great minds from all over the world working toward the common goal of expanding our knowledge. "I have never seen anything even remotely as effective at breaking down cultural barriers as the environment of learning and exploration that NASA has created. At the same time, I have not seen a single project that didn't hold the promise of numerous terrestrial applications despite being developed with space exploration in mind." ■