Alan Pierce
pierceaj@techtoday.us

A Space Suit That Simulates Gravity

It is only a matter of time before our astronauts return to the moon, travel to an asteroid, and eventually go to Mars. In science fiction movies, spaceships are often as large as a small city. They spin slowly and thereby generate a centripetal gravity effect. Some day these megaships might exist; but in the near future our space-faring heroes will need to spend long periods of time working and living in zero gravity environments.

Working in zero gravity is physically difficult because your muscle power can easily act as a propulsion system, sending you in the opposite direction of your applied force. For example, if if a person tries to turn a tight valve clockwise while freely floating in zero gravity, the valve won't move but the person trying to turn it will start to spin in a counterclockwise direction. This problem is now solved by having our astronauts hold onto solid handholds near each area where they need to perform physical labor.

If you can't bring gravity to the spaceship, perhaps you can bring the allusion of gravity to the astronaut. NASA's Innovative Advances Concept Program funded research to develop a spacesuit that could deliver some form of gravity directly to the person wearing it. Sounds impossible, but collaborative efforts by engineers and technologists at Draper Laboratory Inc., MIT, and the David Clark Company have actually developed a spacesuit system that can provide an astronaut's muscles and bones a simulated gravity type of resistance to movement. They named their system the Variable Countermeasure Suit (V2Suit). This suit uses gyroscopes to mimic the effects of gravity.

Figure 1 shows how the spacesuit will include a number of modules; Photo 1 shows how each module will contain a number of mini gyroscopes. Together they will orchestrate a controlled gyroscopic precession to resist any directional movement of the astronaut. The best way to understand how gyroscopes might simulate gravity is by viewing a YouTube video that demonstrates the power of gyroscopic precession: www.youtube.com/watch?v=GeyDf4ooPdo.

The V2Suit places multiple mini-gyroscope modules at critical locations where the action of the astronaut's muscles need to be resisted. These modules are all wired together. A computer system uses body sensors to determine which muscles the person is using and then the system activates specific gyroscopes in each module to orchestrate an opposing force to the direction of this movement.

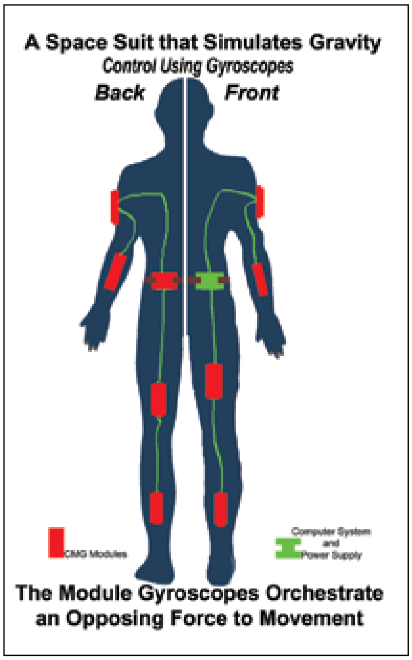

Fig. 1—The CMGs will be located on the suit so they can provide appropriate resistance to movement.

These modules in the V2Suit are called Control Movement Gyroscopes (CMGs). Each gyroscope in a module needs to spin incredibly fast to make up for its small size. To keep the astronaut safe in case of a mechanical failure, they are placed into strong cases. In Photo 1, notice how many bolts will lock down the cover that was removed so you can see its internal structure.

The system can provide resistance to the movement of an astronaut's arms and legs by activating the required gyroscopes. The computer system can also tell all the modules to push the astronaut down so he can walk on the floor of his spacecraft without his physical movement propelling him off the ground.

Photo 1—The gyroscopes spin at a constant 15,000 RPMs and the computer rotates them to create the appropriate force.

The system is about to begin testing. First tests will be performed here on Earth, next in an airplane flying parabolic arcs that create weightlessness, and eventually on the International Space Station.

Recalling the Facts

1. Why is it easier for you to balance your bike when it is in motion rather than when it is standing still?

2. Why does each CMG module have a number of gyroscopes?

Alan Pierce, Ed.D., CSIT, is a technology education consultant. Visit www.technologytoday.us for past columns and teacher resources.

