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Robonaut 2, the legless patent dynamo

Even though it doesn't have any legs (yet), Robonaut 2 is making great strides on the International Space Station. After months of resting comfortably in the newly installed Permanent Multipurpose Module, Robonaut 2, or R2 as it is more affectionately known, has taken a giant leap for robot kind. On May 2nd, R2 began serving the ISS crew in its mission to perform tasks which are too dangerous or mundane for ISS astronauts to perform. The semi-autonomous robot's first task is to monitor air velocity from station vents. This is perhaps a lowly beginning for space robots, but a necessary step for the currently legless anthropomorphic creation.

R2 is the product of a successful development partnership between automotive giant GM and space exploration behemoth NASA. In addition to flying the first humanoid robot to space, more than 40 patents and patent applications have blossomed from the R2 development program. Like many other private company/government agency relationships, the partnership between GM and NASA was heavily influenced by federal laws that govern the agency involved. GM and NASA entered into a Space Act Agreement (SAA). The structure of the SAA was chosen in part to ensure that GM could protect and retain an interest in the intellectual property they developed while working with NASA on next-generation robots.

For those of you unfamiliar with the R2, the robot was developed at Johnson Space Center in the Dexterous Robotic Laboratory. A principal goal of the project is developing humanoid robots which can autonomously or semi-autonomously operate alongside astronauts. A humanoid form factor was chosen so that the robots can use the same tools as their flesh and blood counterparts. This means that NASA only has to ship one set of tools to the ISS, instead of a human set and a set designed for robotic use. Currently, R2 is operating on the ISS. R2 will initially perform simple tasks like monitoring life support system airflow, freeing human astronauts to carry out more challenging tasks. R2 is equipped with stereoscopic cameras and the ability to be remotely controlled by astronauts on the ISS or from a ground station. This teleoperation has a haptic feedback component, enabling the human operator to "feel" the forces encountered by the robot during operation. Because R2 has a body, including hands, designed to mimic the abilities of a human, teleoperators may one day be able to perform EVAs using R2's successors, or to perform remote surgeries on sick astronauts. Currently, R2 is not space rated. R2's electronics would be fried by the radiation and extreme temperature shifts outside the ISS.

Robonaut 2 was jointly developed by NASA and General Motors. The General and NASA began their relationship in 2007 when the two groups signed a space act agreement (SAA). Over the next four years, a pair of R2 robots were developed and constructed under a Space Act Agreement. R2b actually ended up on the ISS, while R2a has been outfitted with a four-wheeled base, enhancing its mobility. NASA is a "title taking" organization which means that under many circumstances, intellectual property rights

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to technologies developed by large companies under NASA contracts like SAAs must be transferred to NASA. The Bayh-Dole Act insulates small companies working with NASA from this title taking and, depending on the circumstance, SAAs can be structured to avoid it too. The SAA between NASA and GM was structured in this manner. The NASA/GM SAA is a reimbursable SAA. That is, NASA and GM are working together on the project, but NASA isn't paying anything out of pocket for development. GM actually pays NASA for the use of facilities. This unfunded SAA gives GM the right to hold the patents on all the technologies they develop for Robonaut 2. To date, some 40 patents or patent applications have been filed on technologies developed for the Robonaut program, including teleoperation technologies and human grasp assist devices. GM hopes to implement many of the technologies developed under this program in its factories so that human and robot workers can produce cars more efficiently.

In the future, R2 may be equipped with legs adapted for locomotion in zero gravity. R2 may also receive upgrades enabling it to perform EVAs while attached to the end of the ISS's robotic arm.

Happy creating!