National Aeronautics and Space Administration

No spare parts needed with new NASA technology that saves on time, space, money, materials

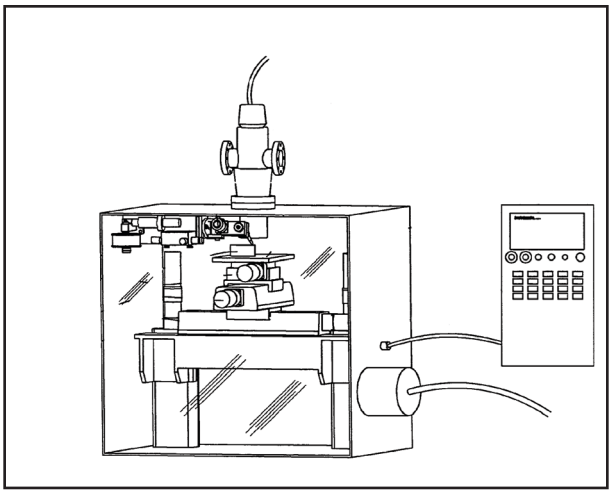
The future of space exploration will involve long-duration missions, and humans will be challenged by constraints aboard spacecraft that will limit the allocation of materials on board. In fact, there will be minimal room for small items like spare parts for machinery and other tools. As a result, it is necessary to consider new approaches to spacecraft maintenance and repair that minimize the mass and stowage volume needed.

NASA's Johnson Space Center (JSC) and Langley Research Center (LaRC) have developed a portable, low-power, solid freeform fabrication apparatus that can produce three-dimensional structural components, objects and parts from a feedstock material using input data, typically from computer-aided design (CAD) data. The development of this apparatus is the result of challenges due to a lack of a small, portable device capable of fabricating three-dimensional replacement parts – especially in remote locations where spare parts are not logistically available.

The device – a sealed container capable of maintaining a vacuum environment – utilizes an electron beam subsystem that directs energy within the container. The apparatus also uses a positioning subsystem, a wire feed subsystem, an instrumentation subsystem connected to an electron beam subsystem and a power distribution system.

In a solid freeform fabrication system, a finished part materializes by layers of material depositing on a substrate. The material can be plastic, metal or ceramic and is photopolymerized, melted or sinerated to shape. Basically, the solid freeform fabrication apparatus provides the capability to introduce feedstock material such as metal wire into a molten pool created by a focused electron beam and ultimately results in the accurate formation and fabrication of three-dimensional structural parts. The part's "blueprint" is stored in a computer design file.

The use of the low-voltage electron beam energy source reduces the radiation so that massive shielding or gear is not required to protect operators and other personnel. Other benefits of the system are its safety, low volume, low mass and efficiency in use of feedstock material. In addition, no die or mold is needed for the parts, which can result in enormous cost and time savings.



Production of replacement components by solid freeform fabrication processes during an extended duration mission or in remote locations could reduce or eliminate the need to carry a complete inventory of pre-manufactured spare parts.

Although the development effort was geared for the eventual use of this type of apparatus aboard spacecraft in flight, the basic system design also could be adapted to other industries in which spare parts are needed on demand at locations far from warehouses and conventional manufacturing facilities.

The capabilities and benefits provided by this system can be valuable to military maintenance activities in forward operating locations, sea-faring ships, offshore oil rigs and production facilities, polar research stations and any other activity that takes place in remote or hostile environments. This technology meets a growing need within the manufacturing industry to reduce the lead time from design to finished product.

Patent 7,168,935 Solid Freeform Fabrication Apparatus and Methods has been issued for this technology. Anyone interested in partnering with NASA to license the technology for commercialization should contact the JSC Technology Transfer Office at jsc-techtran@mail.nasa.gov or 281.483.3809.

tech transfer

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