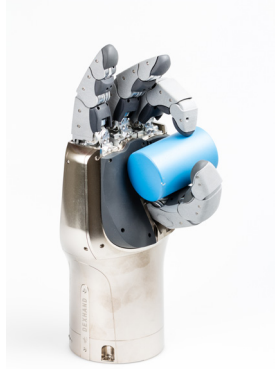


SPACEHAND

Heritage

The Spacehand is based on the technology developed at the German Aerospace Center such as the DLR Hand II design and the anthropomorphic tendon driven hand of DAVID. The space activities such as ROKVISS, MASCOT and Kontur-2 provide a solid space heritage to the Spacehand design.



The Spacehand is one of the tools selected to be part of the RSGS mission of DARPA. The mission aims at inspecting and possibly repairing satellites in GEO. The Spacehand is the most dexterous tool, able to solve the most delicate tasks in case the regular tool set reveals to be inadequate.



DLR at a glance

DLR is the national aeronautics and space research centre of the Federal Republic of Germany. Its extensive research and development work in aeronautics, space, energy, transport and security is integrated into national and international cooperative ventures. In addition to its own research, as Germany's space agency, DLR has been given responsibility by the federal government for the planning and implementation of the German space programme. DLR is also the umbrella organisation for the nation's largest project management agency.

DLR has approximately 8000 employees at 20 locations in Germany: Cologne (headquarters), Augsburg, Berlin, Bonn, Braunschweig, Bremen, Bremerhaven, Dresden, Goettingen, Hamburg, Jena, Juelich, Lampoldshausen, Neustrelitz, Oberpfaffenhofen, Oldenburg, Stade, Stuttgart, Trauen, and Weilheim. DLR also has offices in Brussels, Paris, Tokyo and Washington D.C.

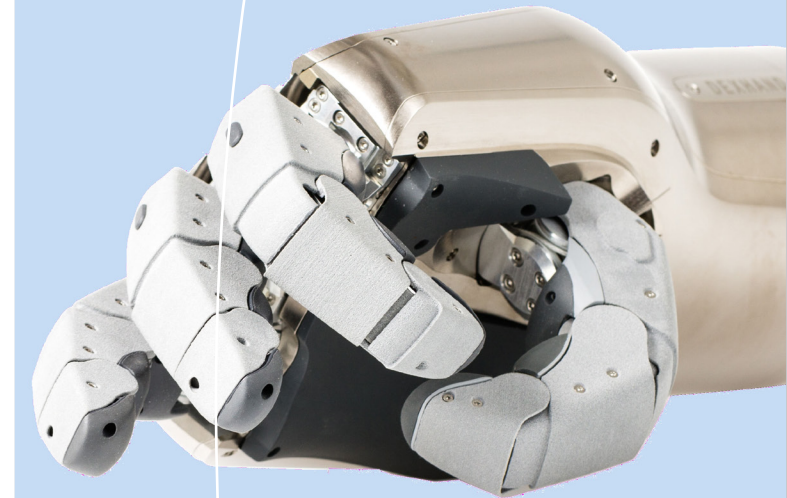
Imprint

Publisher:
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Spacehand

Dexterous robotic hand for space

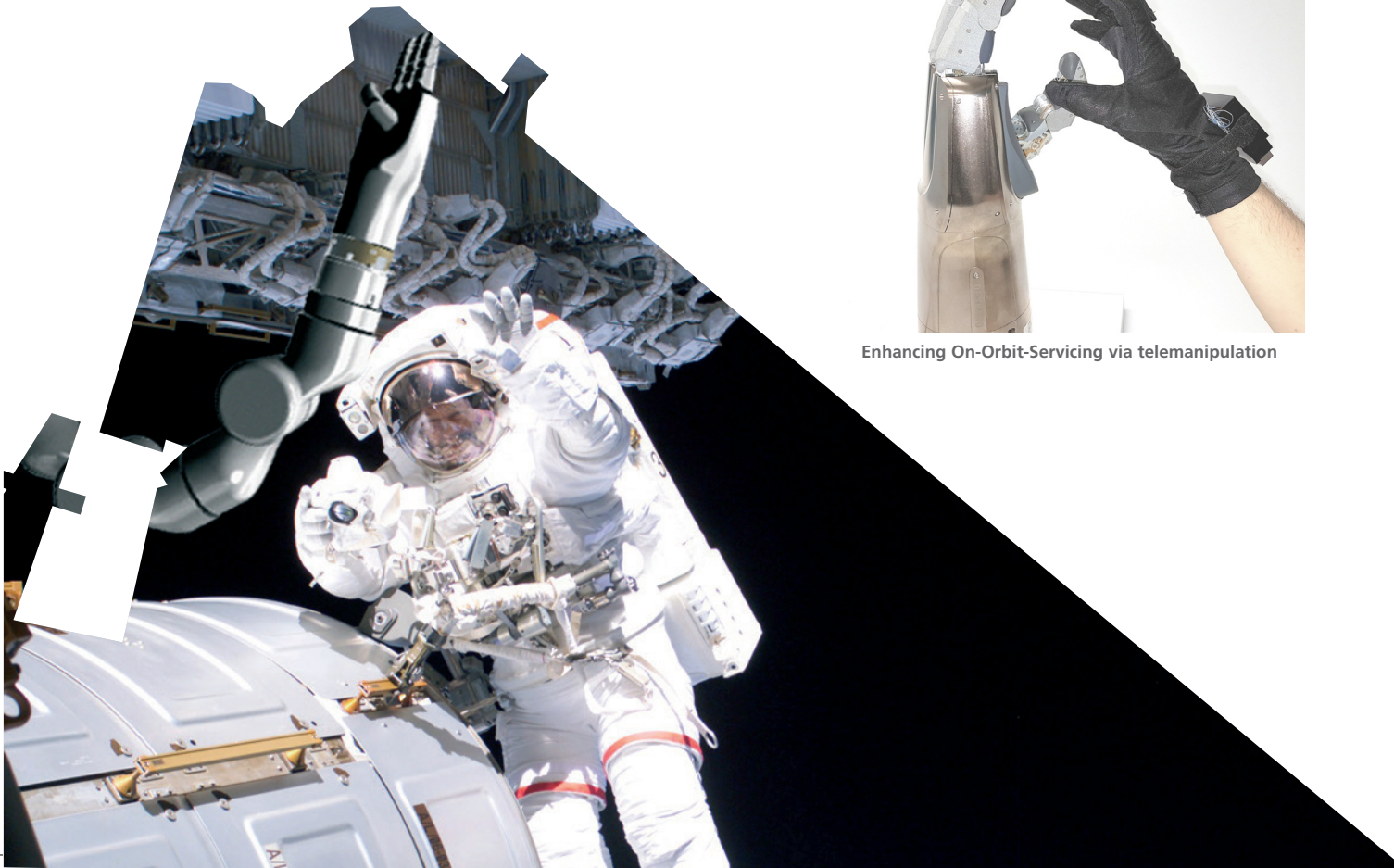
SPACEHAND

Motivation

The tool for the future: In the next years numerous satellites will reach their end of life cycle. Sending astronauts to maintain or repair them is prohibitively expensive and dangerous.

While robotic systems are not yet ready to replace humans, they provide an excellent support for astronauts during maintenance and hazardous tasks.

In more hazardous environments, such as GEO orbits, the use of tele-manipulation interfaces or autonomous execution is the only option to perform highly dexterous inspections and repair missions.



The Spacehand: The Spacehand is a highly dexterous multi-fingered robotic hand designed for a multi years GEO operation. It has three fingers and a thumb, with a total of 12 actuated degrees of freedom. The combination of a high performance embedded computation platform and torque sensors allows the Spacehand to interact softly with its environment.

The Spacehand is specifically developed to control the interaction forces with the environment, preventing any excessive interaction force that could damage the target system.

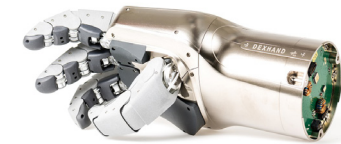
It is able to grasp and manipulate most of the astronauts EVA-tools. It can be used via a telemanipulation interface or via a set of autonomous commands, thus adapting to the available communication infrastructure.



Enhancing On-Orbit-Servicing via telemanipulation

Applications

The Spacehand can be used to perform delicate On-Orbit-Servicing tasks or execute autonomous maintenance tasks that require more dexterity than more primitive tools can provide.



Full integrated robotic hand

Technical Description

System overview

- Designed for GEO operation over several years
- 12 actuated degrees of freedom
- Finger torque measurements for soft interactions
- Telemetry and logging capabilities
- Spacewire interface
- Easy to integrate 24 V - 38 V DC

Mechanical overview

- EVA glove size
- Actuation and sensors integrated in the hand
- Tendon driven fingers
- 25 N active Fingertip force (Thumb 40 N), passive 100 N stretched out
- Highly integrated motor modules
- 12 actuated degrees of freedom
- Weight about 4 kg

Electrical overview

- Fully integrated electronic
- Onboard power management
- Integrated thermal control
- Combination of FPGA and DSP

Software

- Telemanipulation interface (Kinfinity Glove)
- Autonomous operations
- Controller parameters adjustments
- Ground Graphical Interface