CAESAR - True Service Robotics Technology for In-Orbit Assembly, Maintenance, and Repair

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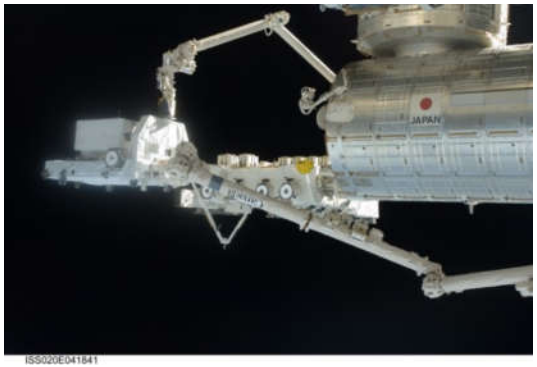
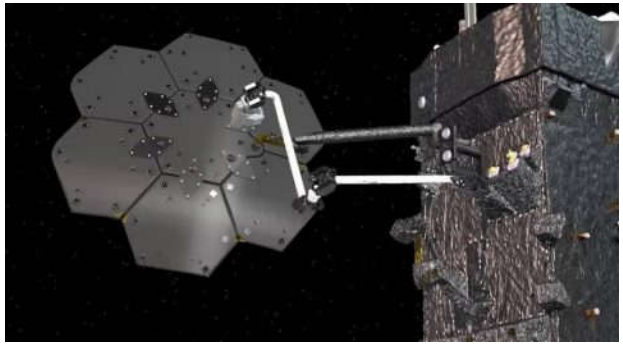
Robotics and Service Robotics





Current space robot arms are remindful of industrial robot arms of the mid-nineties.

- very stiff hence accordingly heavy
- position controlled
- unsensitive with regard to the environment

A service robot is different

- Lightweight
- Not stiff but compliant
- Equipped with sensors especially force/torque sensors
- Position and compliance controlled

DLR Experience in Building and Using Light-Weight Service Robots

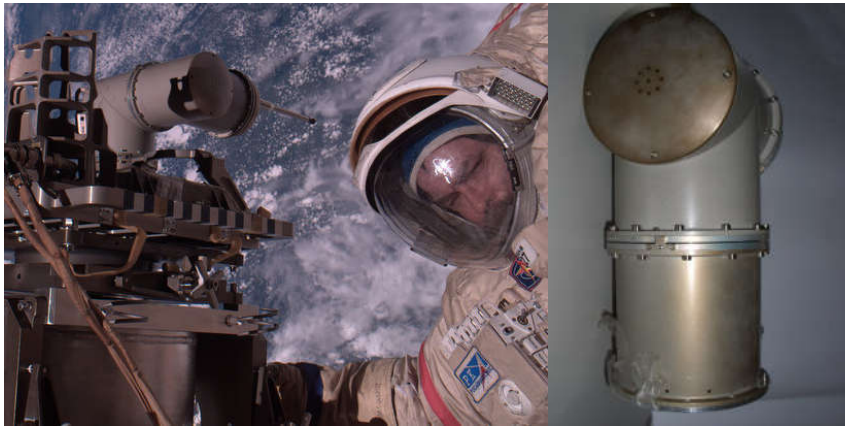
Change of paradigm in robotics:

From large, rigid and position controlled to light-weight, compliant, and adaptable

DLR Light-Weight Robot 1
1995

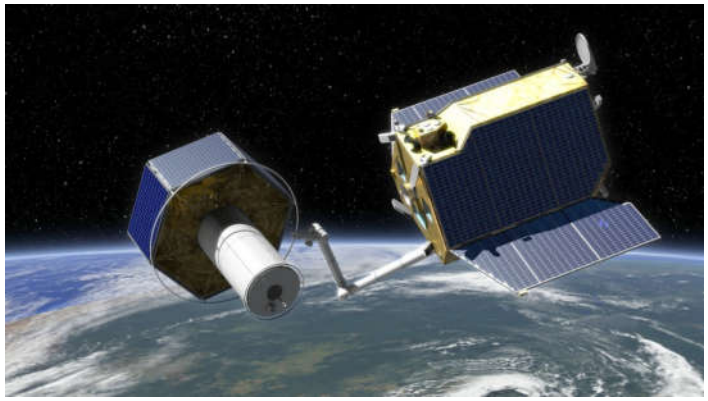
DLR Light-Weight Robot 3
2003

Technology transfer to KUKA

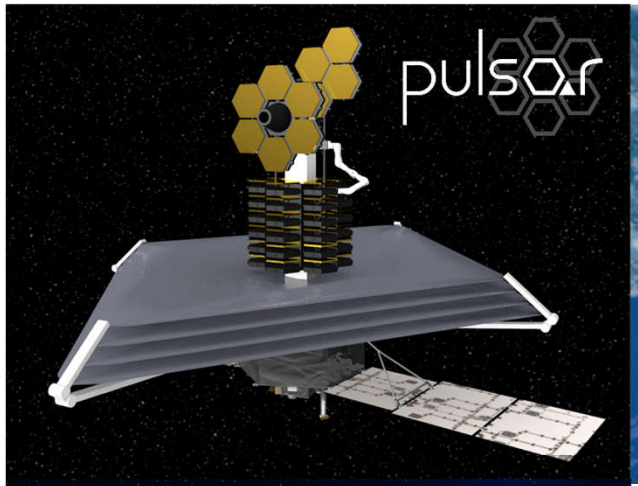


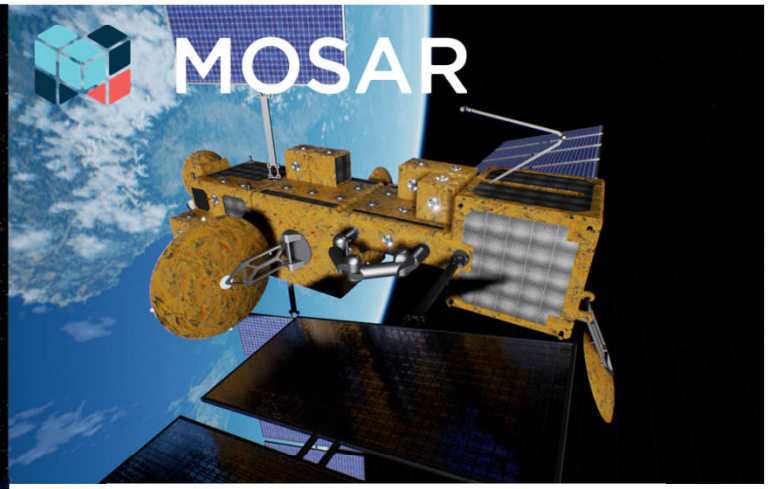
ROKVISS: Technology Verification on ISS

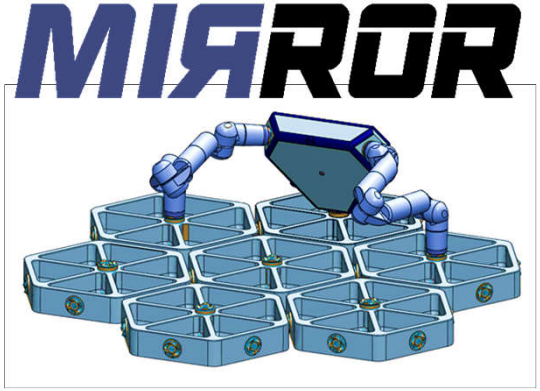
Active Participation in On-Orbit Servicing Projects



Deutsche Orbitale Servicing Mission
(DEOS 2014)



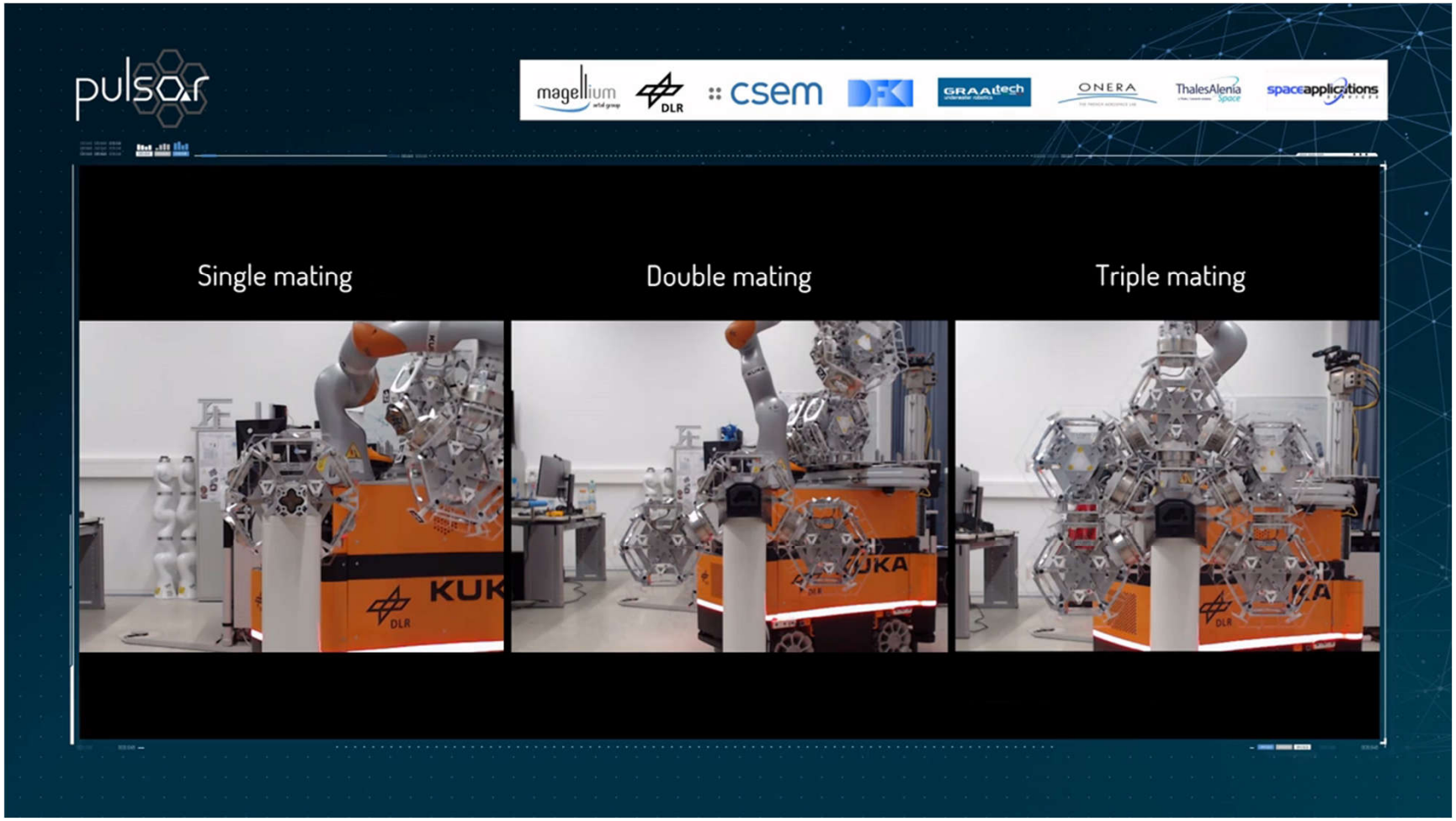




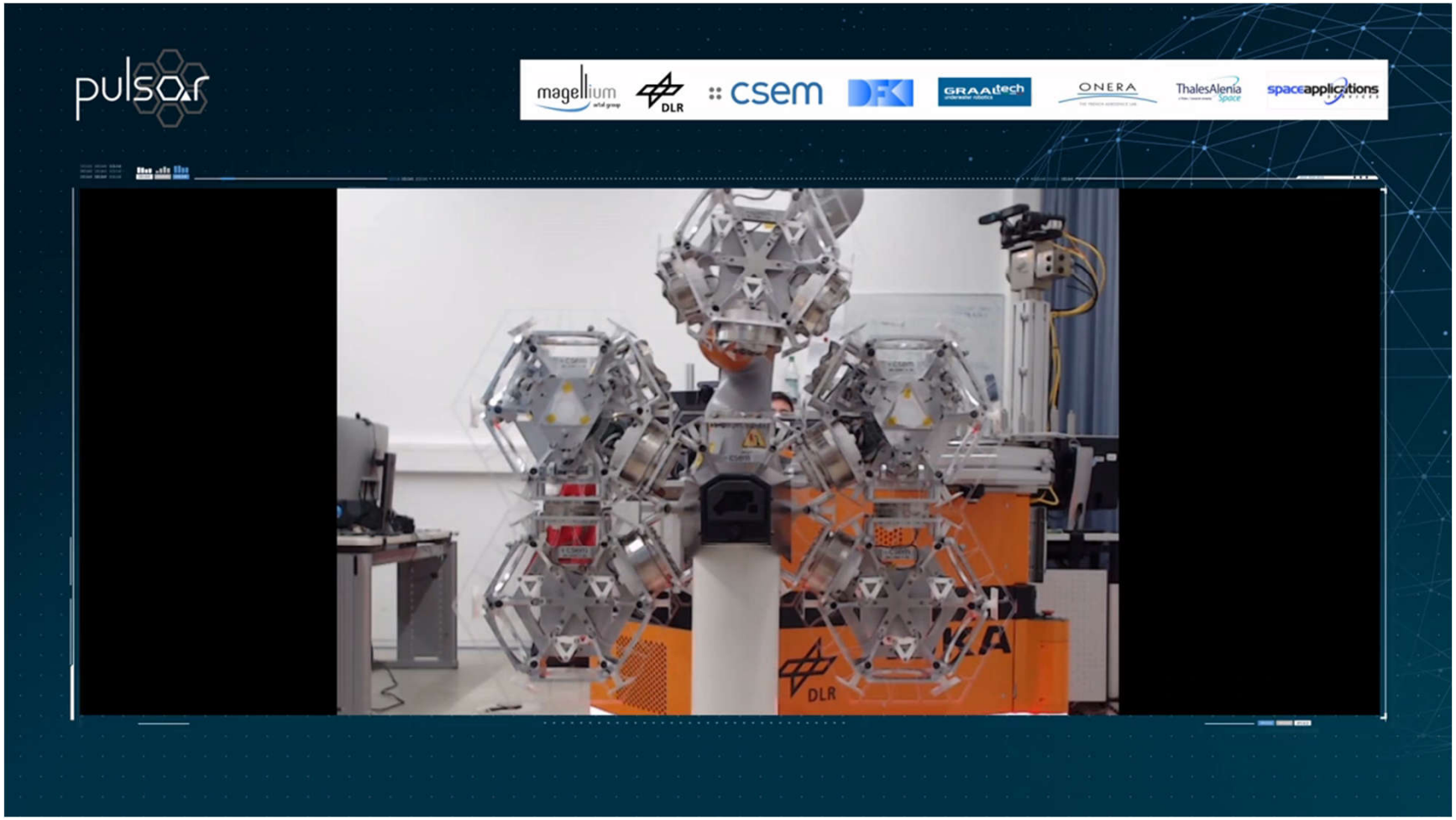
2019 -2022

DLR

PULSAR: Assembly of a Space Telescope



PULSAR: Assembly of a Space Telescope



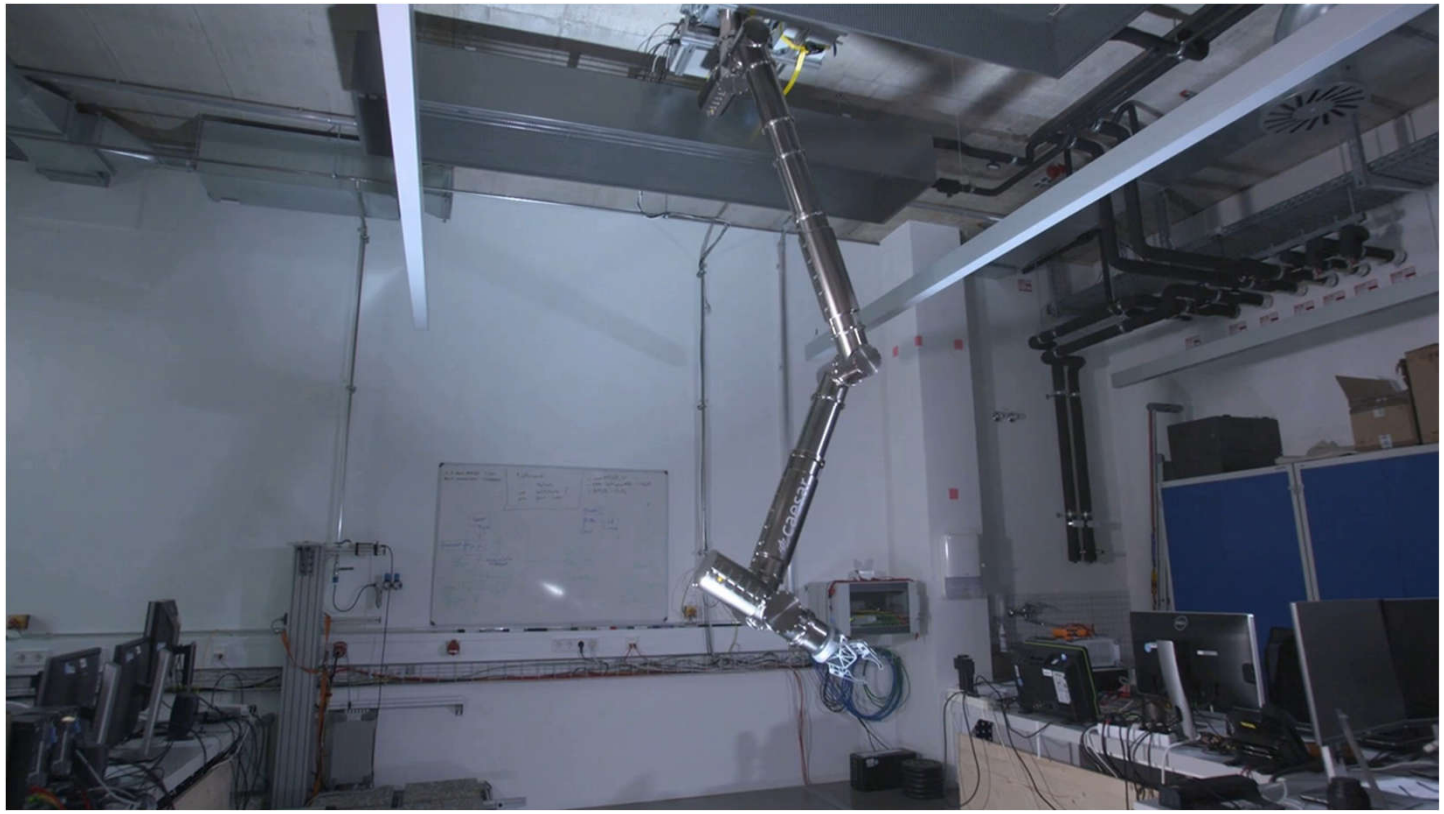
DLR - **C**ompliant **A**ssistance and **E**xploration **S**p**A**ce- **R**obot (CAESAR)

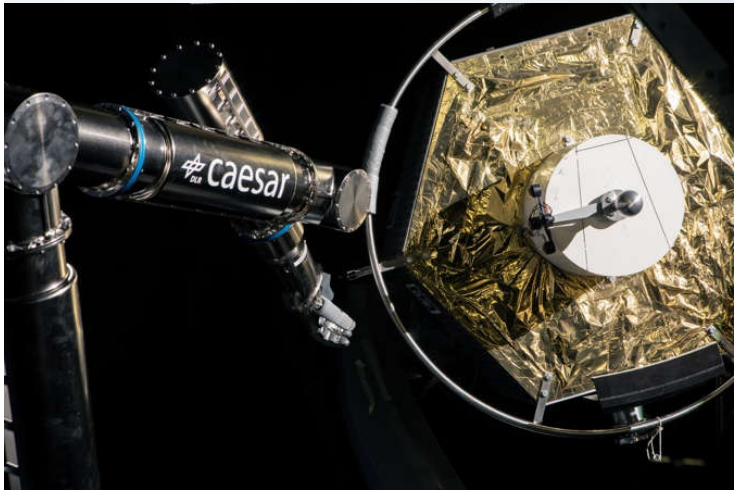
- The CAESAR design requirements are [illegible] the use-cases in LEO, GEO, deep space as well as on Moon or Mars.
- Production and qualification of CAESAR is efficient and accurate → ensuring commercial success and confidence in operation.
- CAESAR is adaptable to various carriers and different types of satellites or space crafts.
- Due to its modular design different configurations / kinematics are possible.

Manipulator	
Joint Position Sensor Resolution	82.830 inc / 320°
Motor Position Sensor Resolution after Gear	11.650.644 inc / 320°
Length of Manipulator arm	2.4m + x (7dof)
RA Mass	~ 60kg
Thickness of Aluminum Housing	2mm
Internal Databus	Deterministic, real-time EtherCAT with 100MBit/s
Range of Motion	320° for all axis
Joint output torque	80Nm for all axis
Joint velocity	Up to 10°/s
Environment	
Operational Temperature	-20°C to +60°C
Non-Operational Temperature	-50°C to +80°C
Radiation Hardness	40krad TID (with additional shielding 100krad TID)
Mission Time	Up to 10 years

CAESAR Requirements (excerpt)

CAESAR – Engineering Arm





Q&A

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