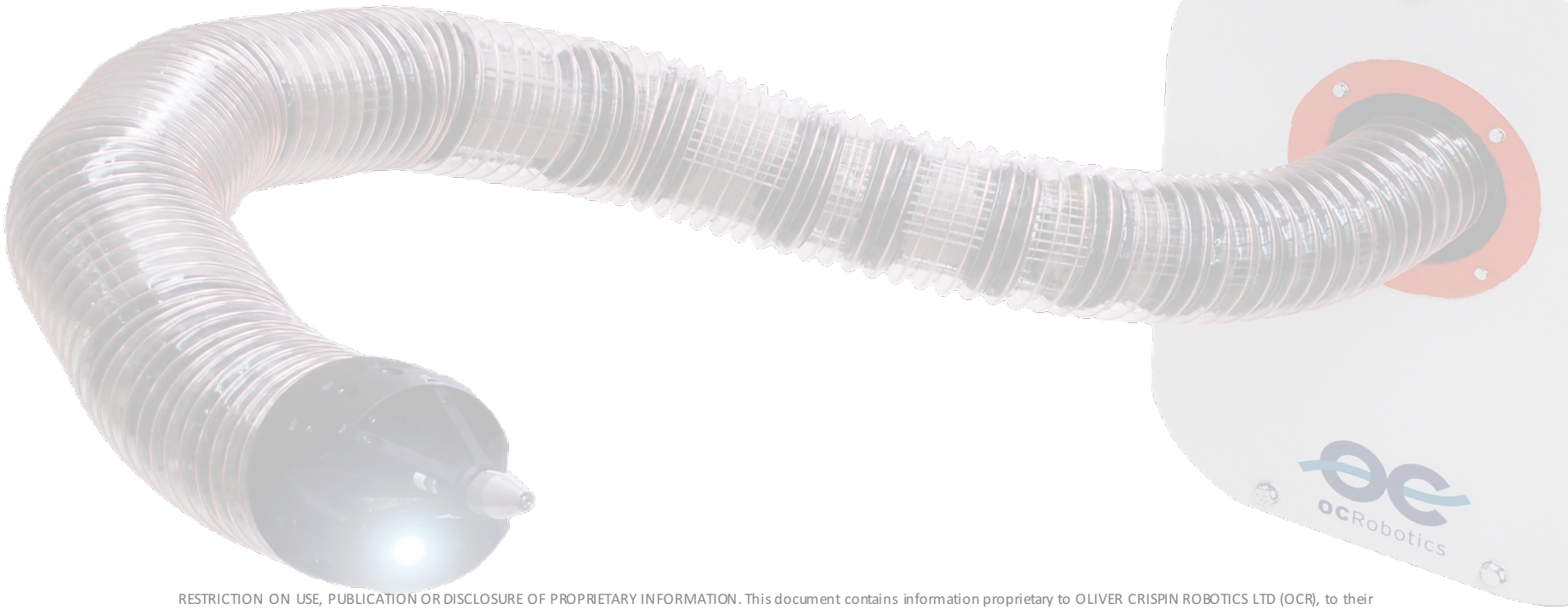
OC Robotics

Snake-arm robots for nuclear applications

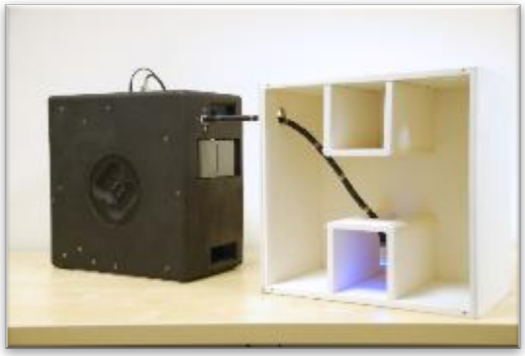
4th Feb 2016

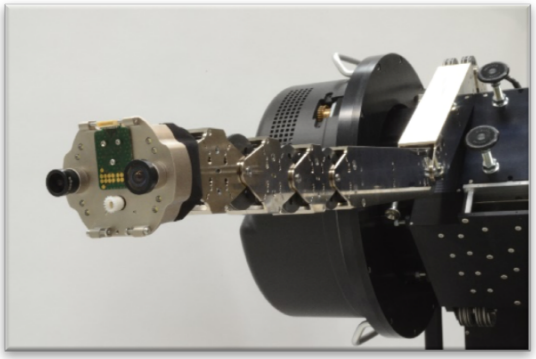


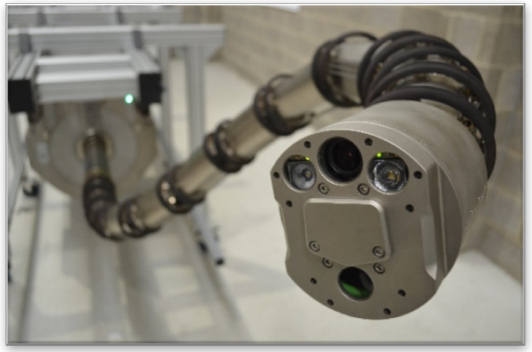
Snake-arm Robots for Nuclear Applications

Introduction to OC Robotics & snake-arm robots

- OC Robotics was founded in 1997 to be a leading provider of robotic, engineered solutions
- SME based in Bristol, UK
- Robots have been developed for a wide variety of applications:
  - Nuclear inspection & repair
  - Aerospace
  - Defence – investigation & bomb disposal
  - Oil & gas inspection
  - Tunnel boring machine cleaning & inspection
  - Power plant inspection

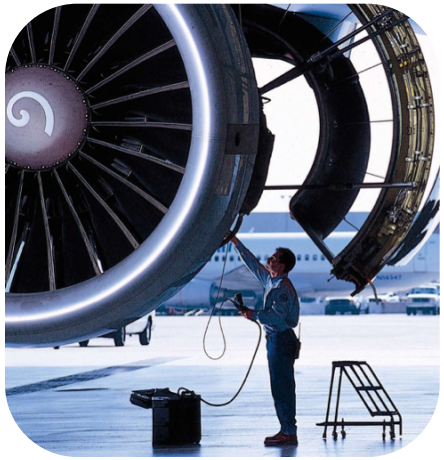






Snake-arm Robots for Nuclear Applications

OC Robotics & snake-arm robots



Flexible 'scopes

Small, flexible inspection tools for accessing confined areas.
Not self-supporting.
Limited controllability.
Zero accuracy.
Limited or zero payload capacity.

Snake-arm robots

Flexible robots for accessing confined areas.
Self-supporting.
Controllable & steerable.
Excess DOF enables obstacle avoidance.
Moderate accuracy.
Moderate payload capacity.

Industrial robots

Stiff, stable movable platforms.
Self-supporting.
Limited collision avoidance capability.
High accuracy.
High payload capacity.

Snake-arm Robots for Nuclear Applications

Introduction: arm construction

- Plug-in arm base for quick change
- Wire rope driven
- 1- or 2-DOF joints between links
- Continuous, hollow bore for services
- Tip mounting for tools

Snake-arm Robots for Nuclear Applications

Introduction: nose-following

- Nose-following motion mode

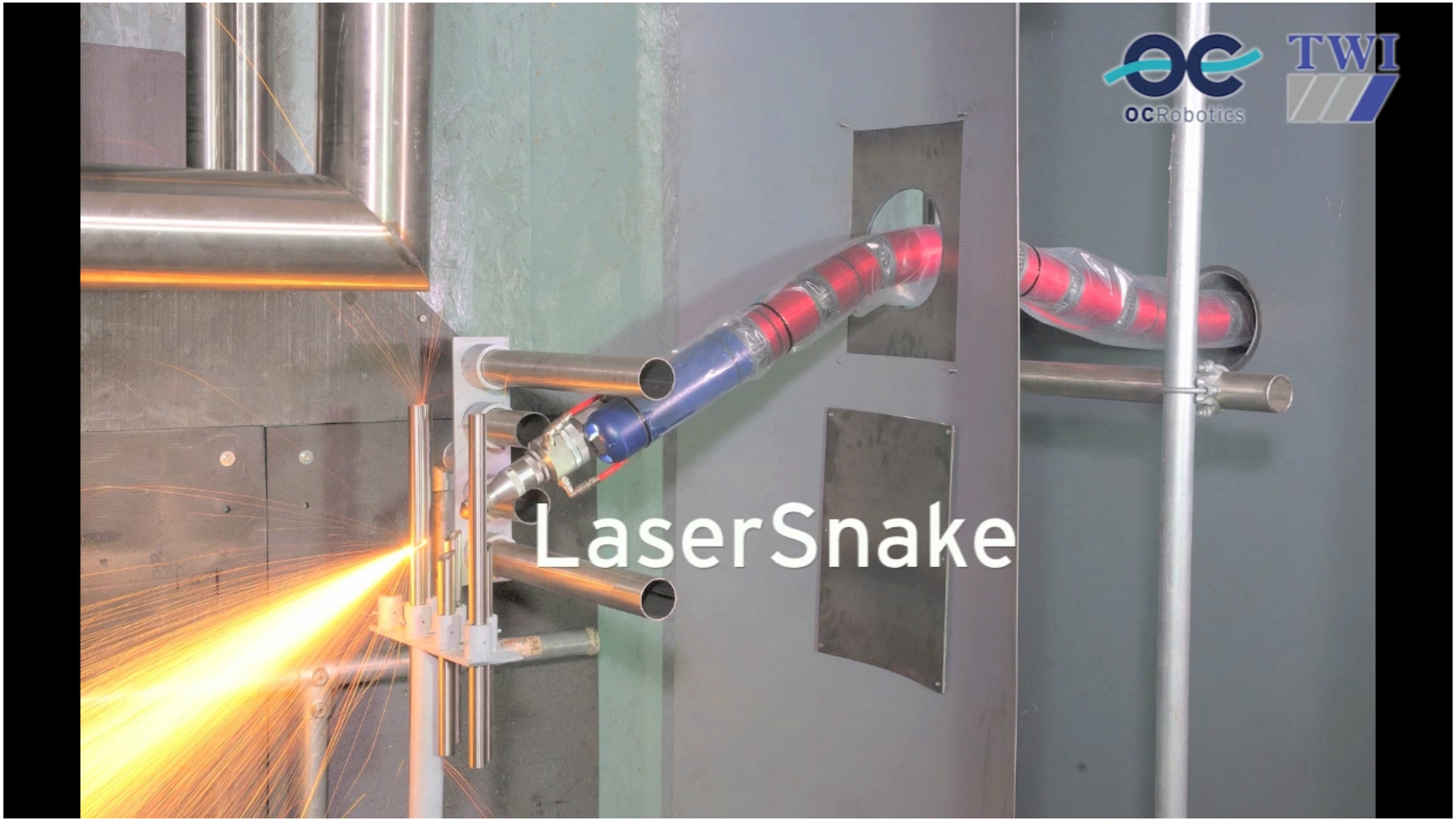
Snake-arm Robots for Nuclear Applications

Projects: LaserSnake

- Nuclear decommissioning
- Reduce frequency of human intervention or enable decommissioning where human access impossible
- Deliver single sided non-contact cutting by fibre laser
- Remotely operated
- Lower fume than other hot cutting methods

Snake-arm Robots for Nuclear Applications

Projects: LaserSnake

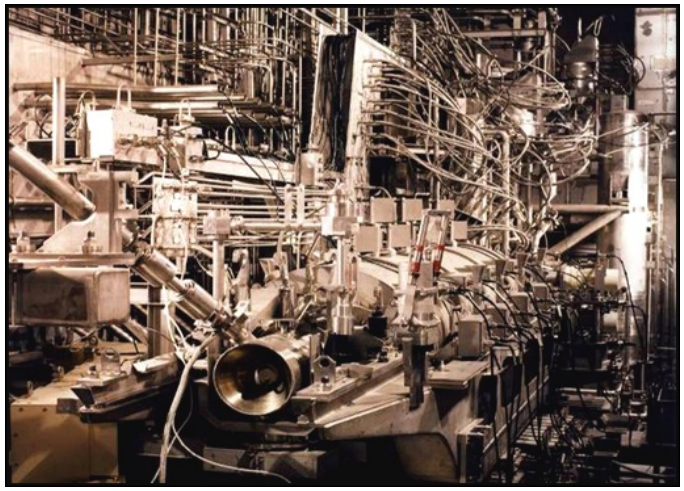


Snake-arm Robots for Nuclear Applications

Projects: LaserSnake2

The challenge

- Decommissioning of complex and hazardous environments
- Industry-wide aim to minimise personal dose uptake
- A need for remote solutions to safely conduct decommissioning



Projects: LaserSnake2

LaserSnake2

- Collaborative R&D project
  - integrating robotic delivery systems and laser cutting for nuclear decommissioning
- In-situ and ex-situ decommissioning processes
- Develop safe, cost efficient solutions for high-hazard confined spaces

OCRobotics

NATIONAL NUCLEAR LABORATORY

TWI

ULO Optics

Laser Optical Engineering Ltd

Supported by

NDA Nuclear Decommissioning Authority

Department of Energy & Climate Change

Innovate UK Technology Strategy Board

Snake-arm Robots for Nuclear Applications

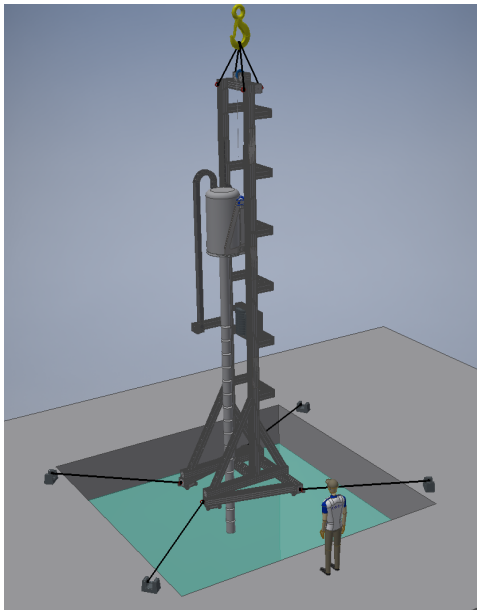
Projects: LaserSnake2

- Why laser cutting?
  - Traditional methods: Reciprocating saws or grinders
    - Complicated to re-engineer hand-held tools into remote systems
    - Slow and time-consuming
  - Laser cutting head integrated with robotic system
  - Already being implemented in other industrial sectors

Snake-arm Robots for Nuclear Applications

Projects: LaserSnake2

- Long reach snake-arm – 4.5m articulation
- Active laser cutting trials at Sellafield
- Under water operation
  - Snake-arm
  - Laser process head
- Payloads
  - Laser cutting tool (up to 10kW)
  - Grippers
  - Mechanical cutting tools
  - Laser scanners
  - Radiological sensors



Snake-arm Robots for Nuclear Applications

Projects: LaserSnake2

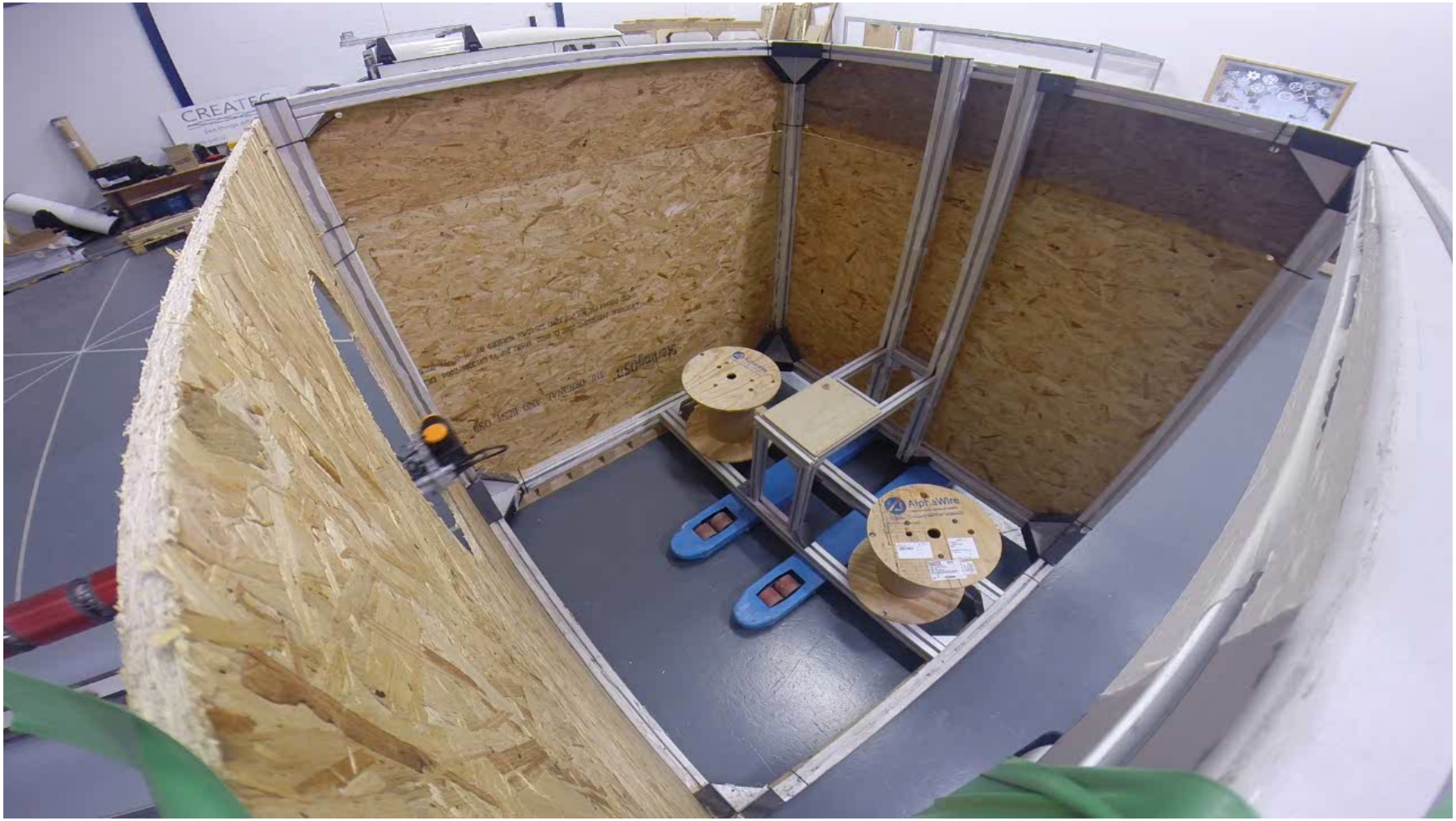
Snake-arm Robots for Nuclear Applications

Projects: LaserSnake2

- Active trials at the First Generation Reprocess Plant in Sellafield in May 2016

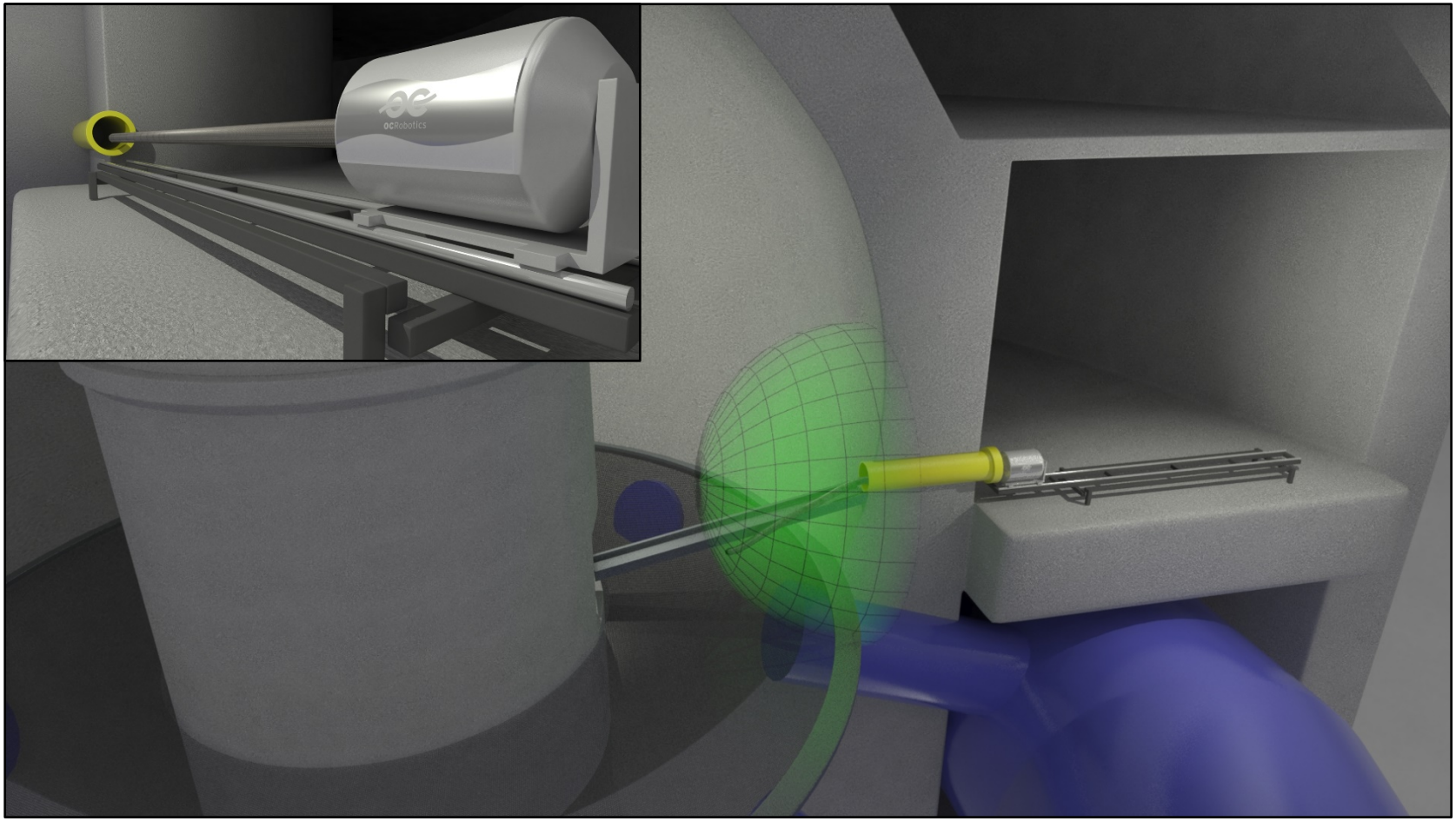
Snake-arm Robots for Nuclear Applications

Projects: SeeSnake



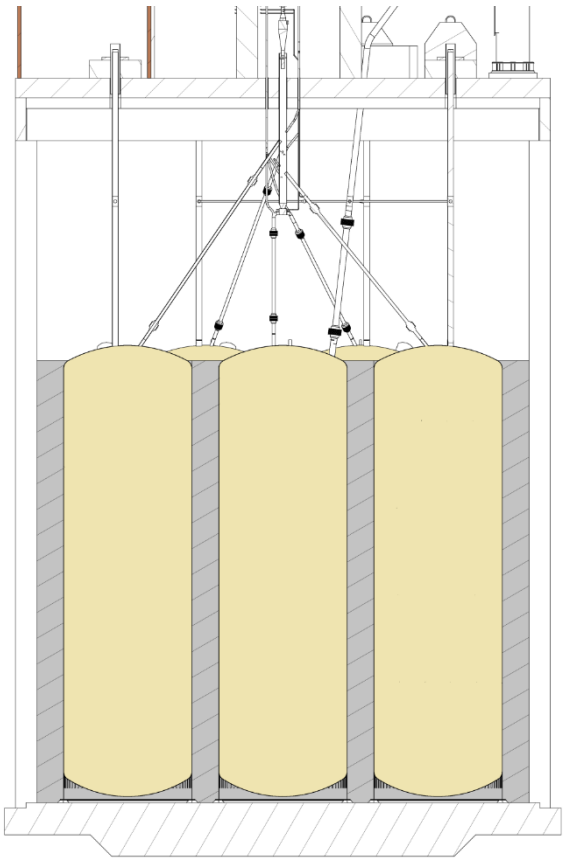
Snake-arm Robots for Nuclear Applications

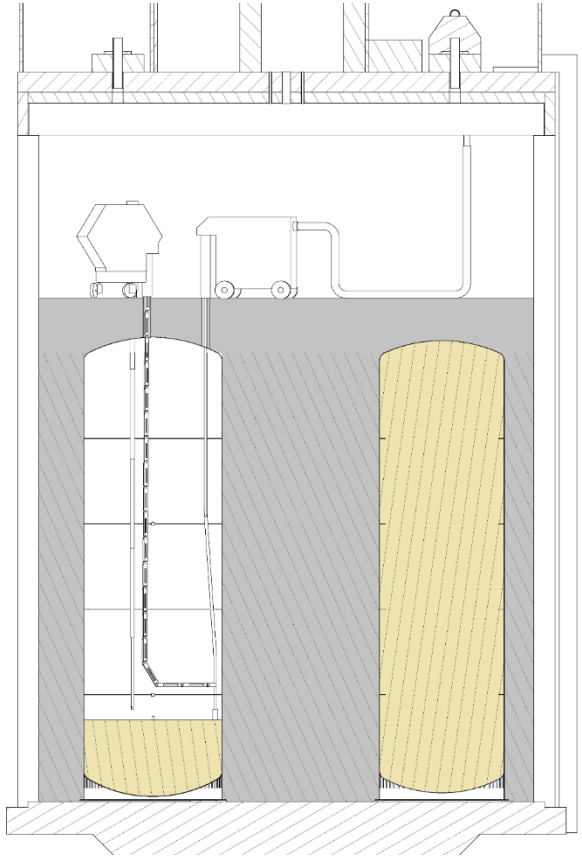
Projects: IRID Feasibility study

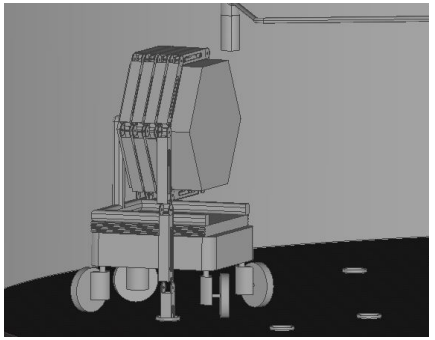


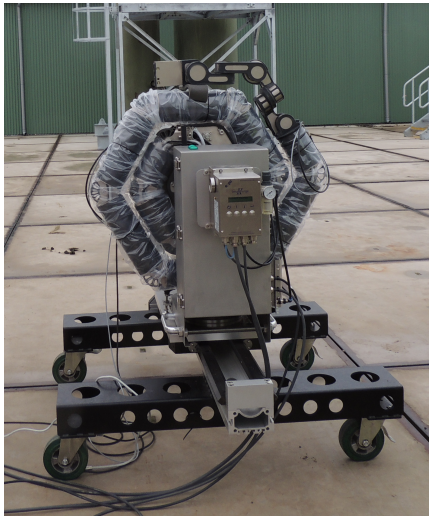
Snake-arm Robots for Nuclear Applications

Projects: DOE tank inspection and retrieval







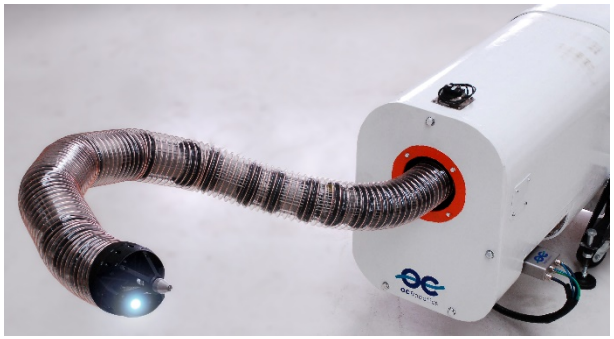


Snake-arm Robots for Nuclear Applications

OCRobotics

Products - JetSnake (Construction)

- Cleaning and inspection in Tunnel Boring Machine (TBM)
- Robotic intervention required to reduce frequency of human interventions
- Deliver high-pressure cleaning within a dirty, pressurised construction environment
- Perform visual inspection of cutting heads
- Used routinely and for emergent issues



Snake-arm Robots for Nuclear Applications

Products - JetSnake (Construction)

- *TMCLK - Hong Kong*

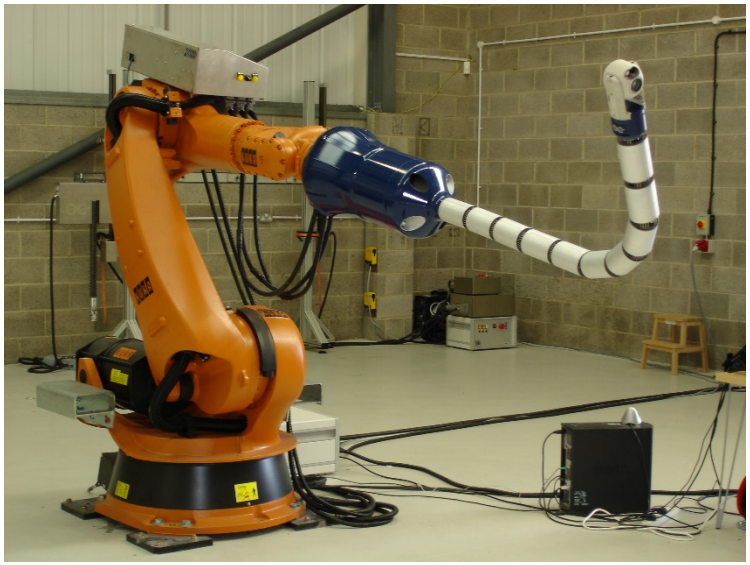
Snake-arm Robots for Nuclear Applications

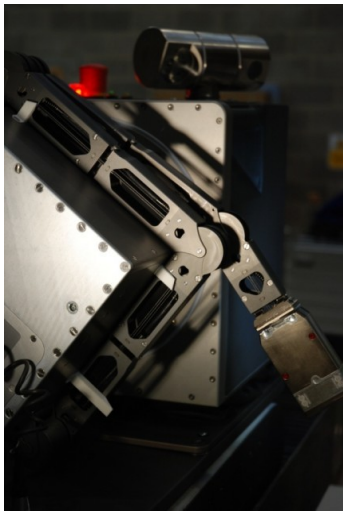
Products – Mobile snake-arm robot

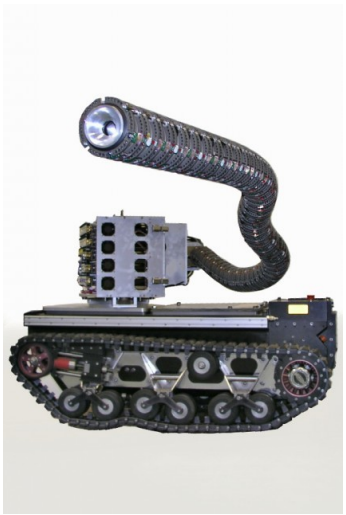
- Oxford mobile robotics group

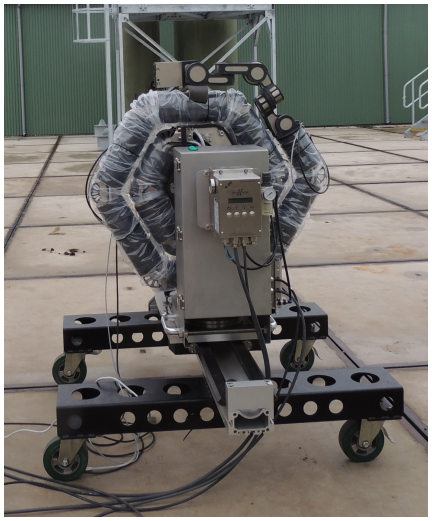
Snake-arm Robots for Nuclear Applications

Integration – complete solutions









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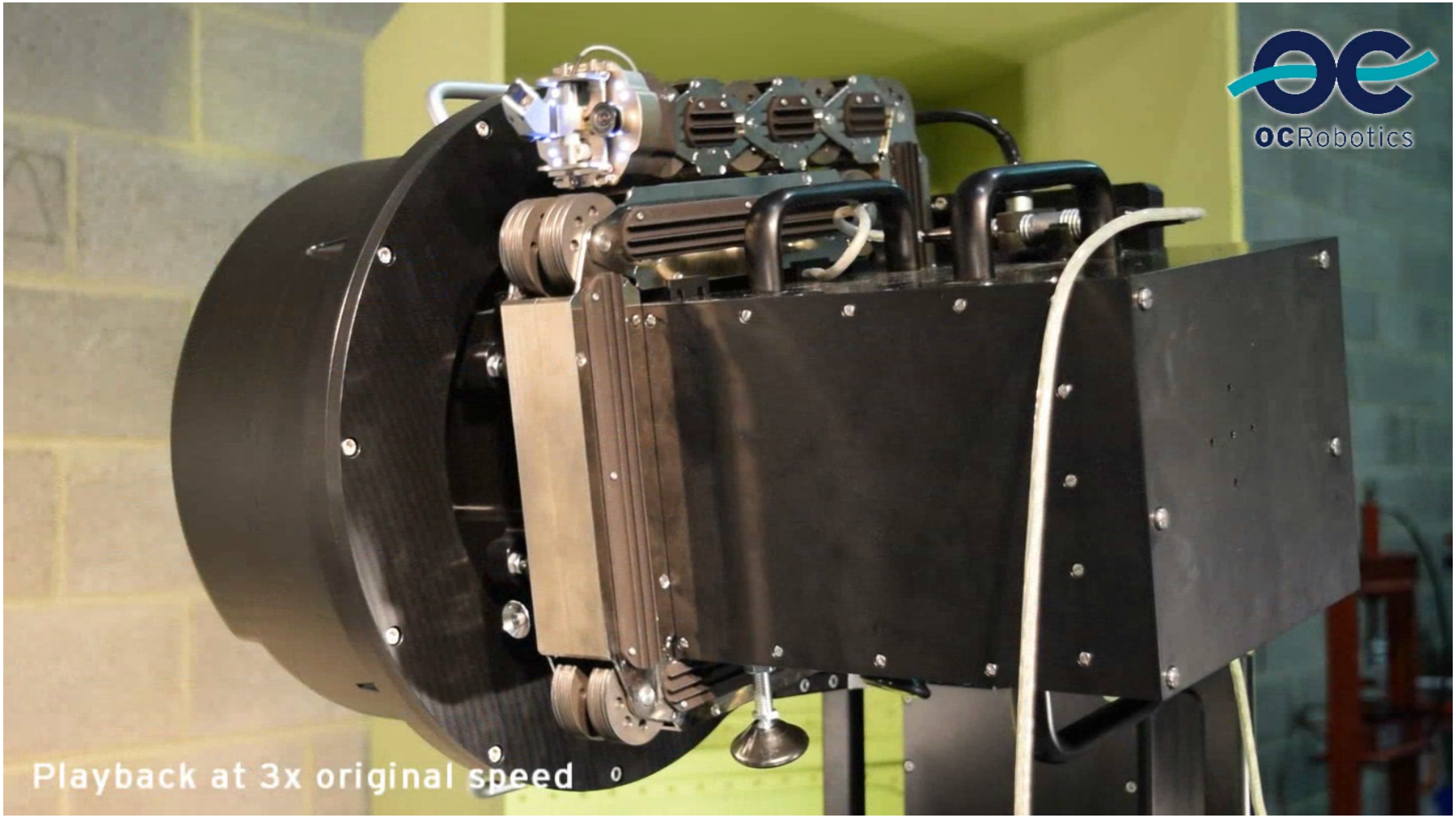
Projects: RANDE (Aerospace inspection)



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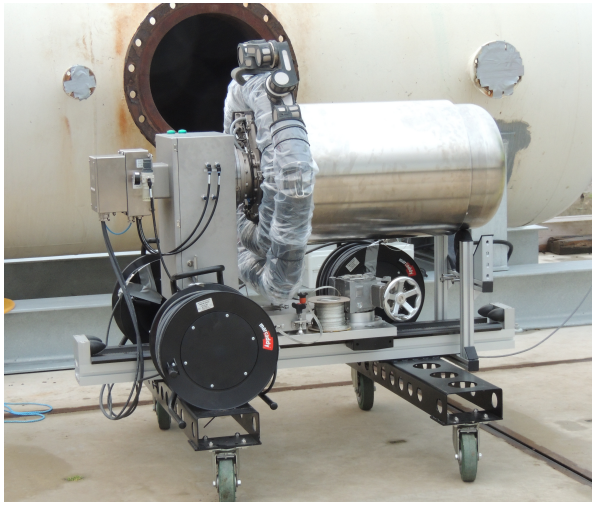
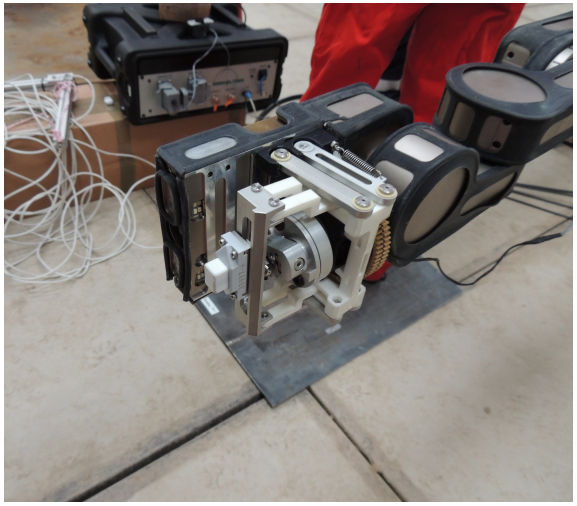
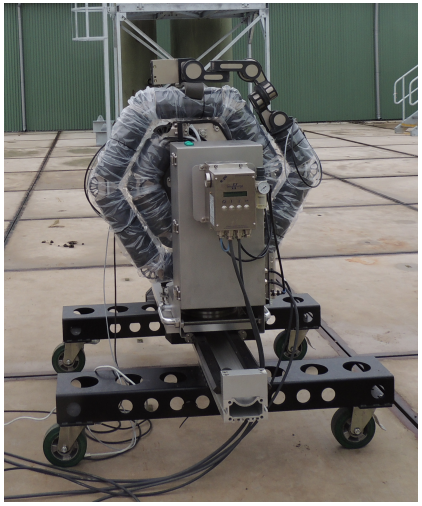
Projects: PETROBOT (Oil and Gas)







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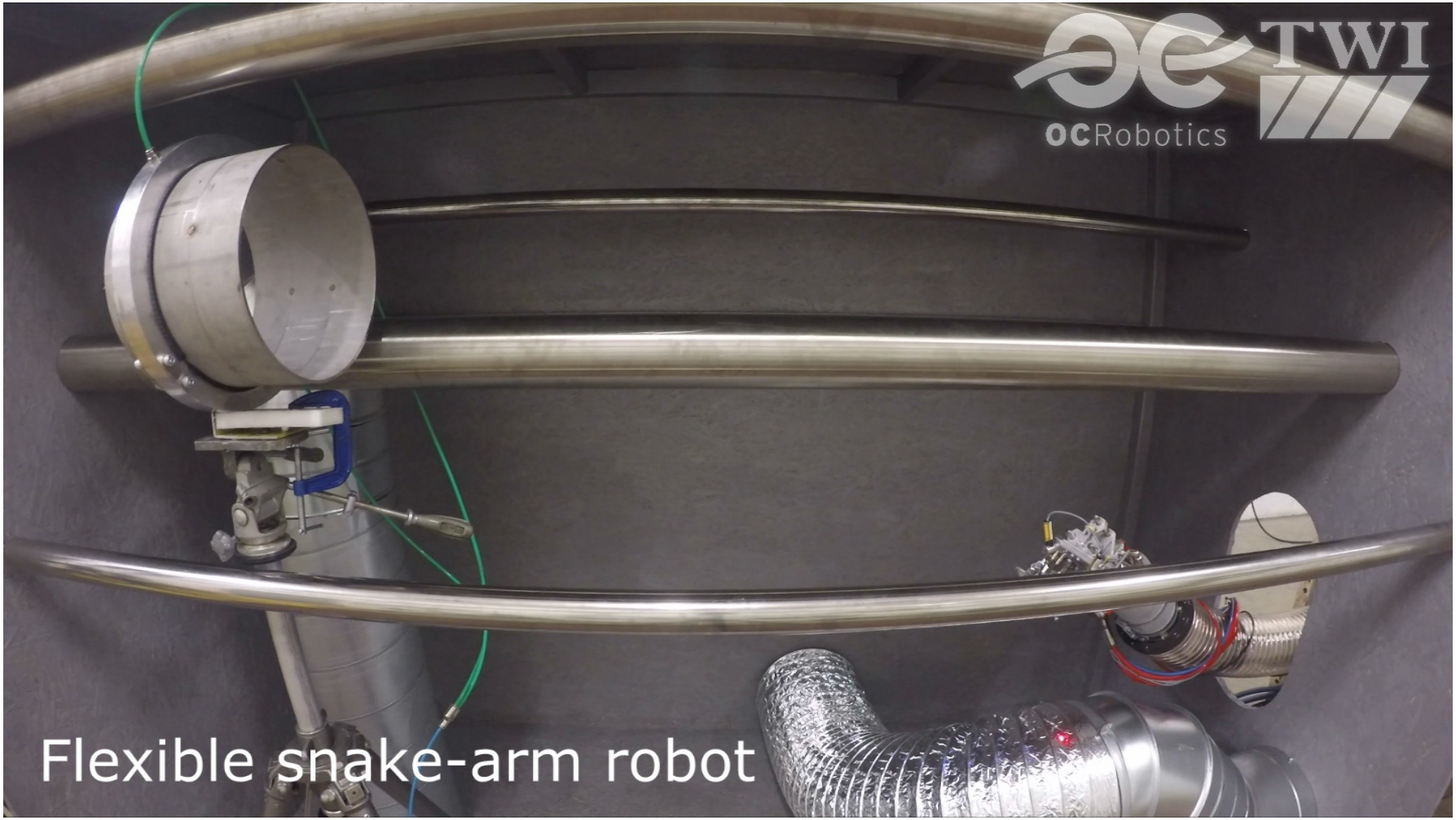
Projects: LaserPipe



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Questions

www.ocrobotics.com

Adam Mallion

adam@ocrobotics.com