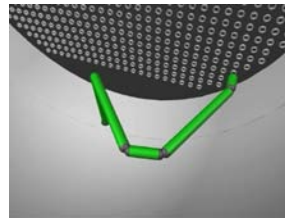
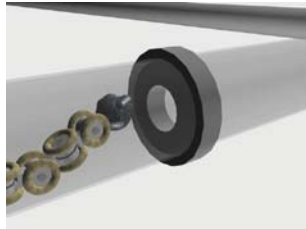


# New possibilities – Next generation robotic systems for inspection and maintenance operations



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*SINTEF ICT Applied Cybernetics*
- Presenter: Gøril M. Breivik  
*SINTEF ICT Optical Measurement Systems and Data Analysis*

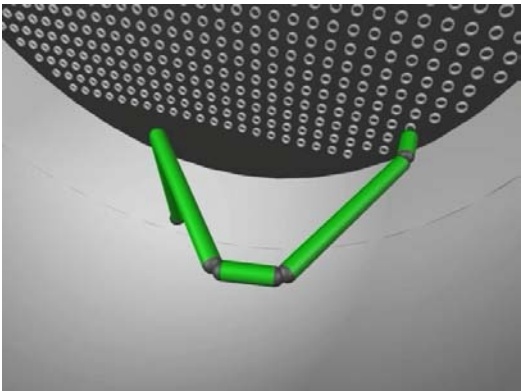
# Outline

- Motivation
- Heat exchanger cleaning
- Firefighting / water spraying
- Pipe-inspection
- Remote control of oil platforms

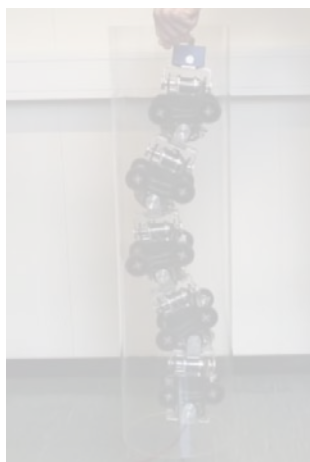
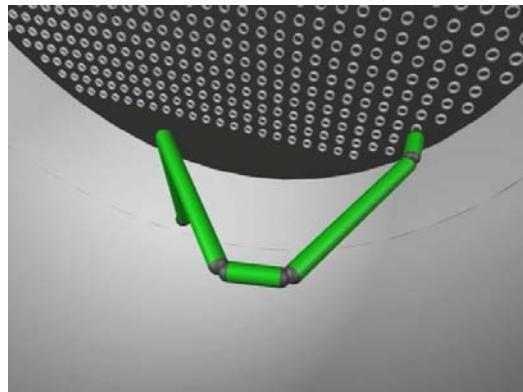
# Motivation

- Estimate: Losses at 0.25 % of GDP of industrialized nations due to fouling in heat exchanger
- Germany: Communal sewers add up to 400 000 km and many are old, but only 11 % are accessible to humans
- Estimate: 49 000 service robots to be installed world wide 2009 - 2012

# Outline

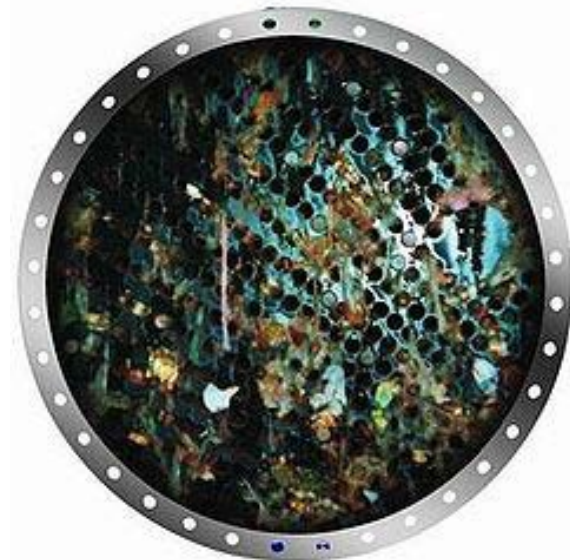
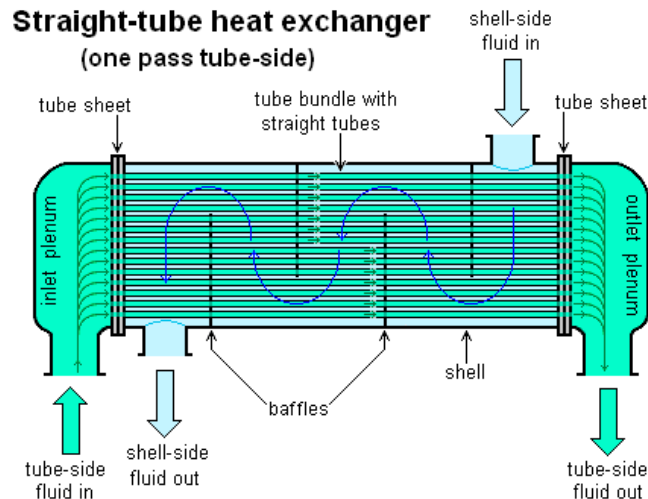


# Outline



# Heat exchanger cleaner - HexCleaner

- Intro to heat exchangers
  - Common component in process plants
  - Transfers heat from one medium to another
  - Problem with fouling – regular cleaning intervals needed



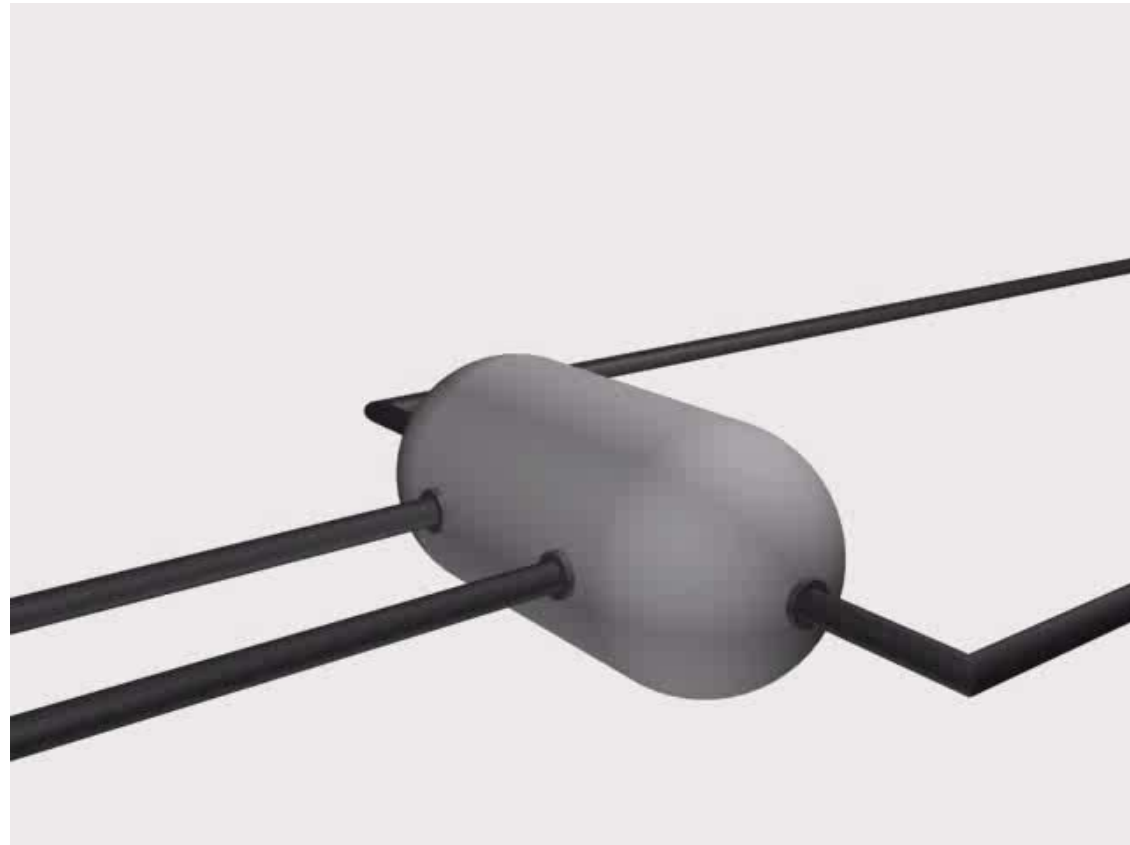
# Heat exchanger cleaner - HexCleaner

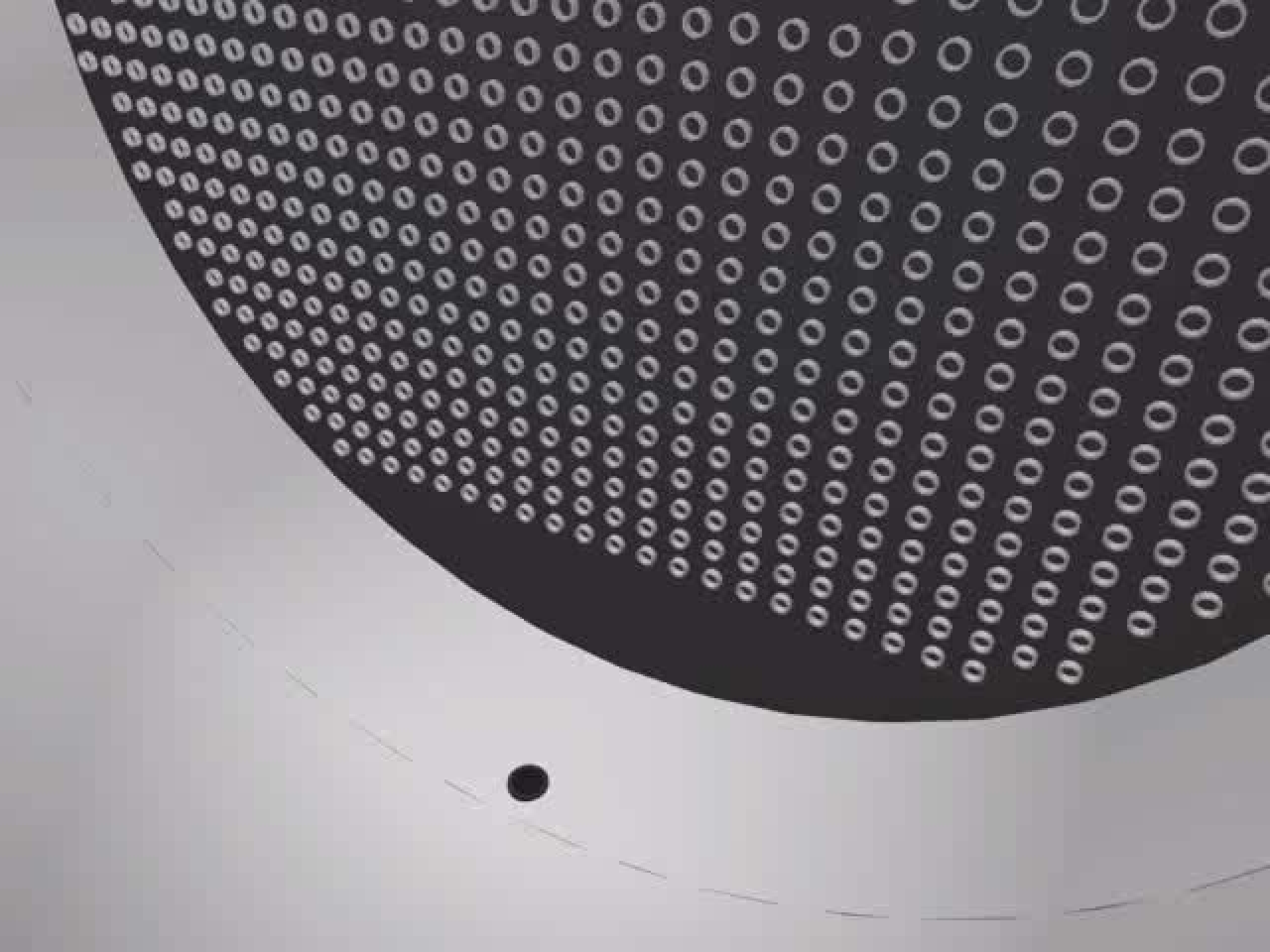
## ■ Case

- Hydrogen gas
- 2 m diameter
- 2000 tubes
- **Only access:  
two inch pipe stub**

## ■ Challenge

- Bring inspection and cleaning tools inside

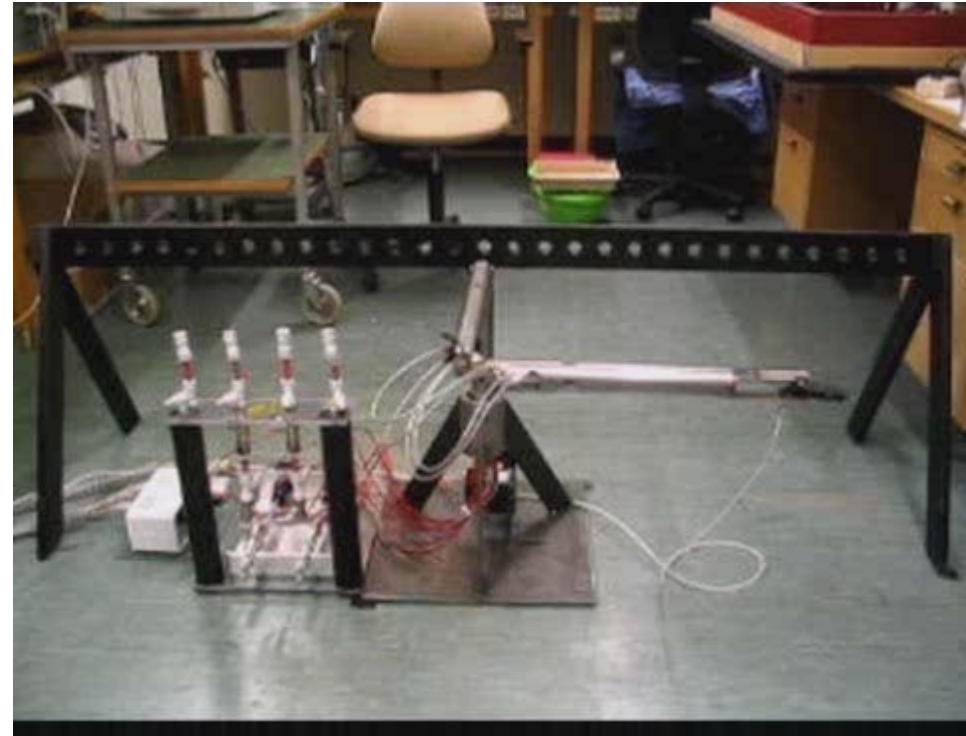
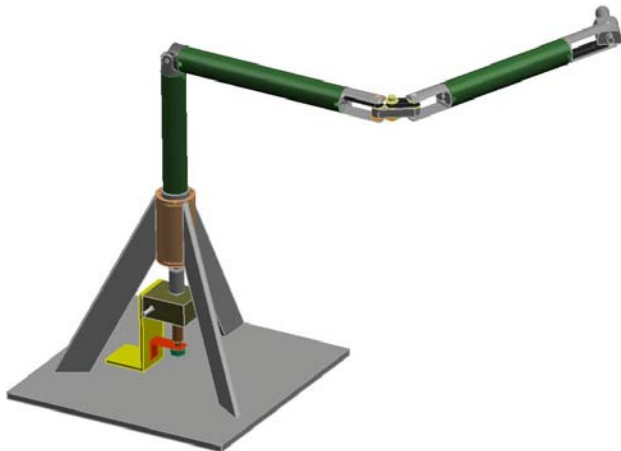




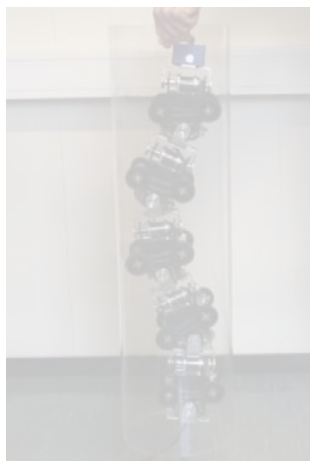
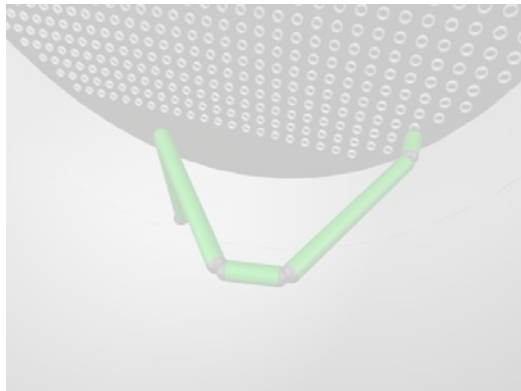


# Heat exchanger cleaner - HexCleaner

- Robot demonstrator
  - Diameter 40 mm
  - Reach 2 m!
  - Drive: hydraulic and electric



# Outline



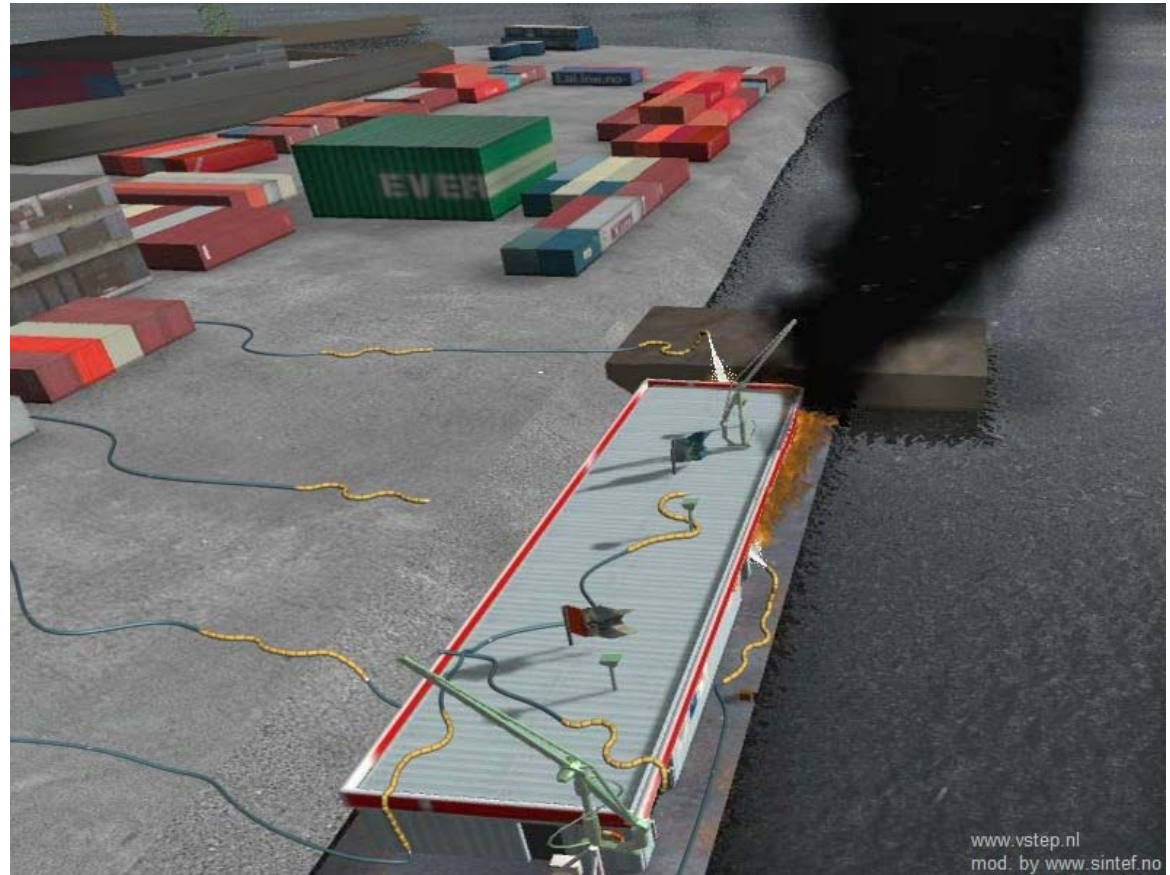
# Fire-fighting / water spraying robot

- **Concept**
  - Intelligent **snake robot** for challenging operation
- **Idea**
  - Equip a fire hose with water hydraulic motors
- **Why?**
  - Enable the fire hose to perform fire intervention on its own
- **How?**
  - Exploit the hydraulic energy inside the fire hose



# Fire-fighting / water spraying robot

- Fire extinguisher
- Search and rescue
- Situation awareness



SnakeFighter: Water-hydraulic fire hoses

# Fire-fighting / water spraying robot

- High risk areas



# Fire-fighting / water spraying robot

- Tunnel fires
- First responders



# Fire-fighting / water spraying robot



# Fire-fighting / water spraying robot

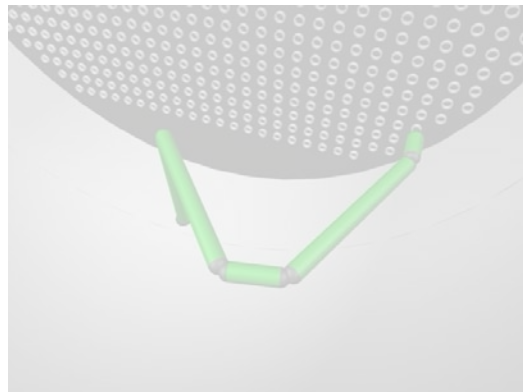




# Fire-fighting / water spraying robot

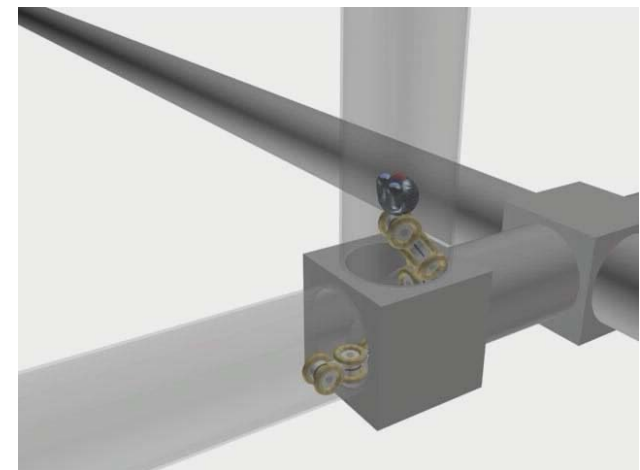
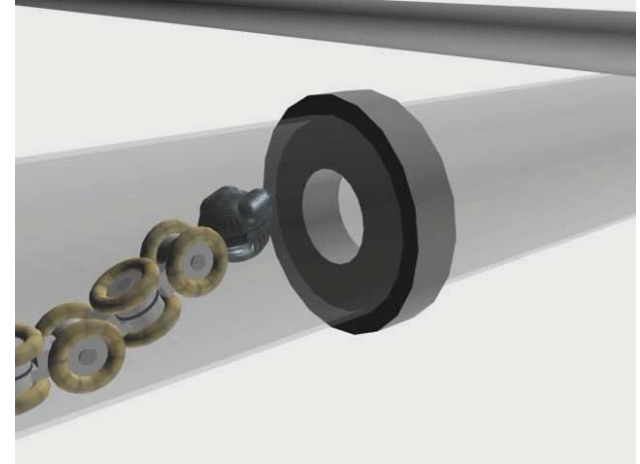
**AIKO**  
**Obstacle-aided**  
**locomotion**

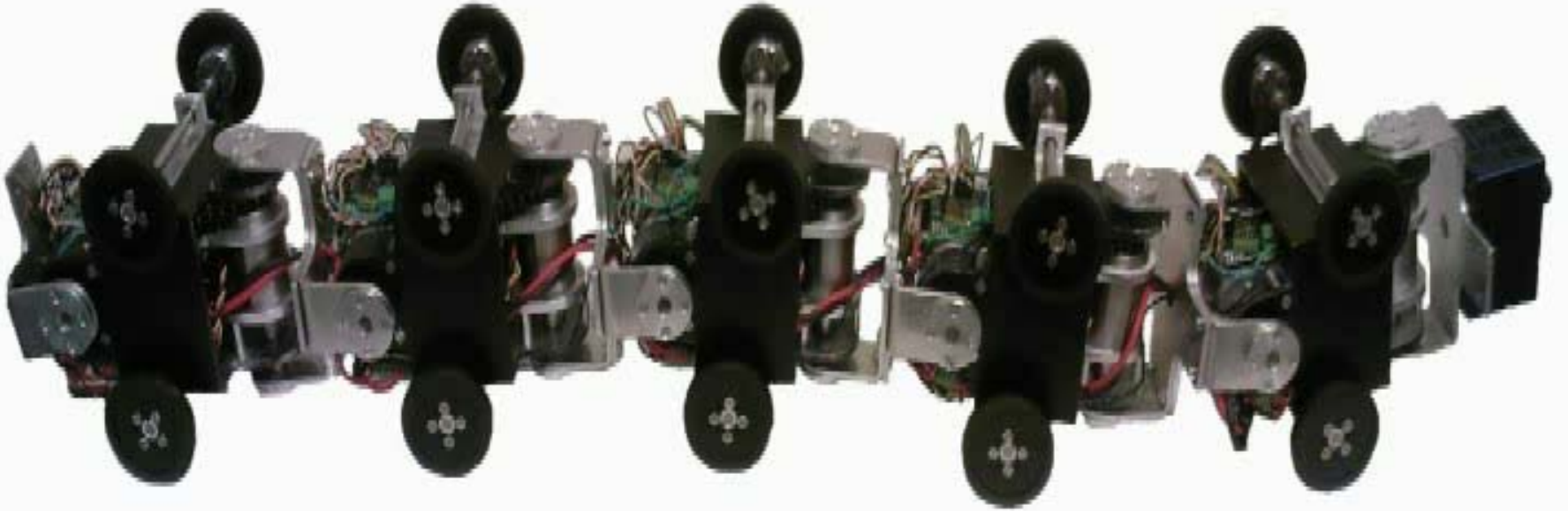
# Outline



# Piko – Pipe-inspection robot

- Inspection and maintenance
  - Water and sewer systems
  - Chemical and nuclear plants
  - Air duct systems
  - Oil and gas pipelines



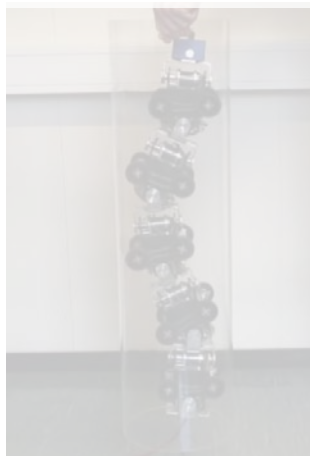
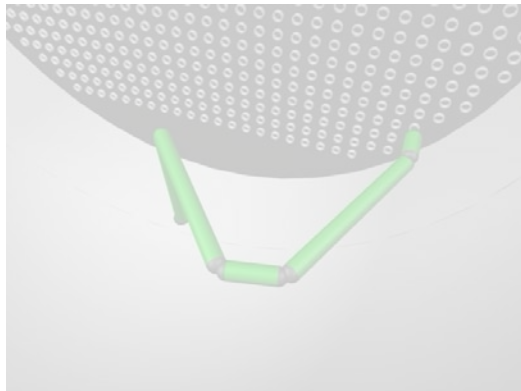


# Snake robots

- Generic application
  - A *transportation system* for arbitrary *tools* and *sensors*
- Advantages
  - Stability
  - Traverse rough terrains
  - Small cross-sectional area
  - Redundancy



# Outline



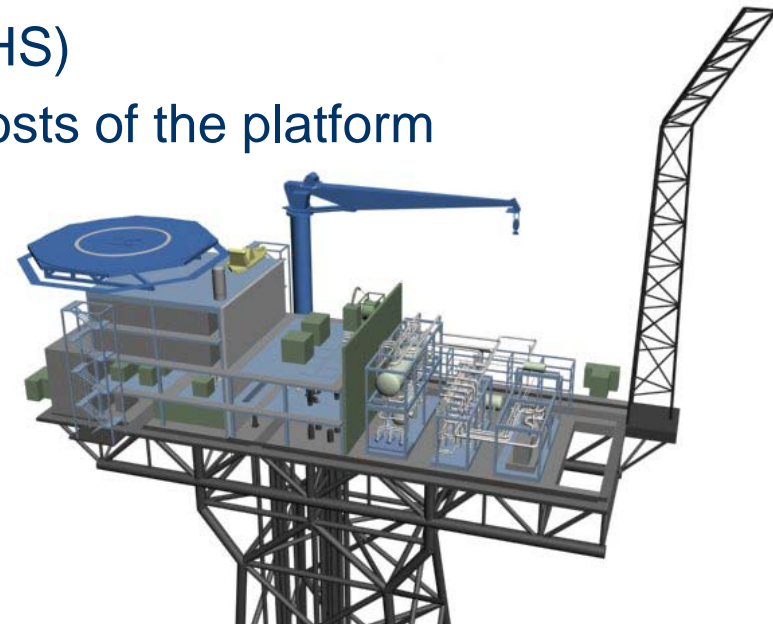
# Remote I&M of oil platforms

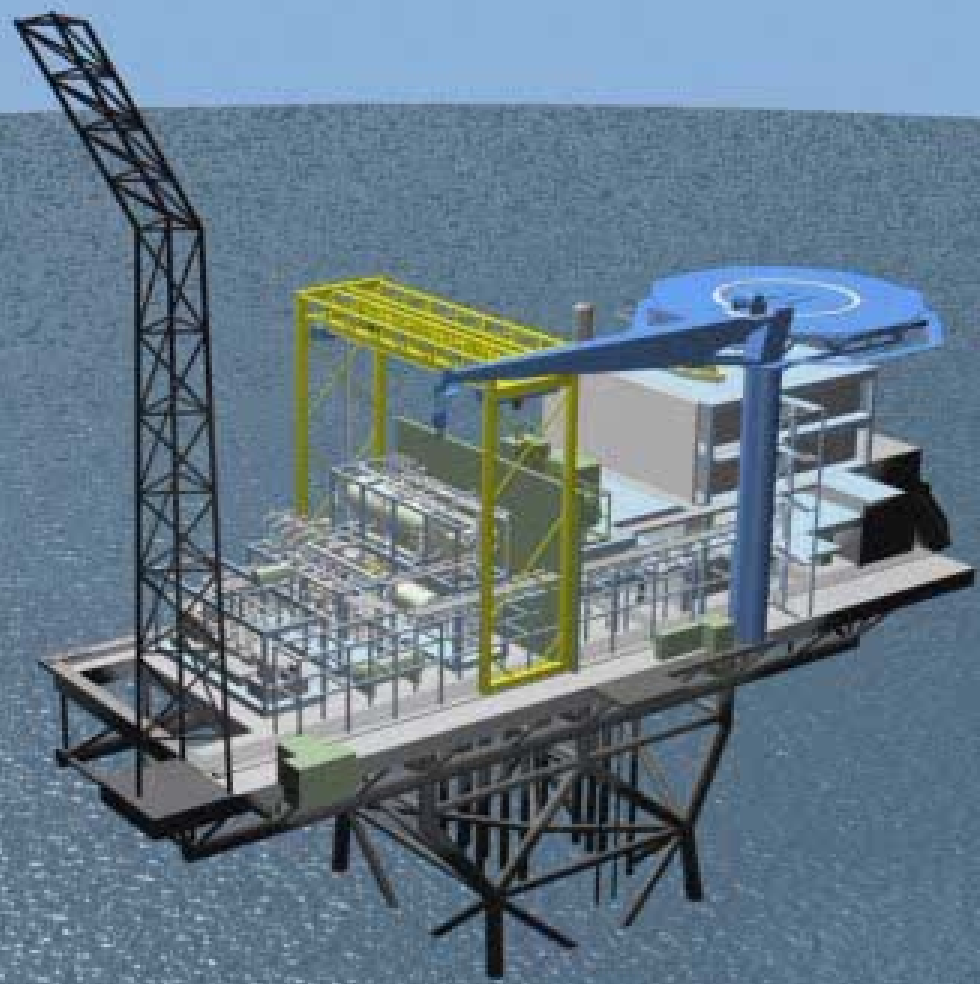
## ■ Concept

- Remotely operated oil & gas platform monitored and controlled by operators onshore

## ■ Motivation

- Environment, Health, and Safety (EHS)
- Reduce investment and operating costs of the platform
- Dry wellhead area (not subsea)







# Remote I&M of oil platforms

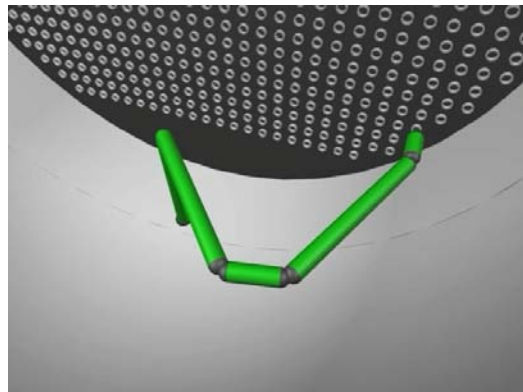
- Located in Trondheim, Norway



# Remote I&M of oil platforms



# Next generation robotic systems for inspection and maintenance



# Thank you for your attention!

Questions?

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