# SARGON

## *How To Build Model Driven Robots*

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8th December 2016, MBSSE Workshop

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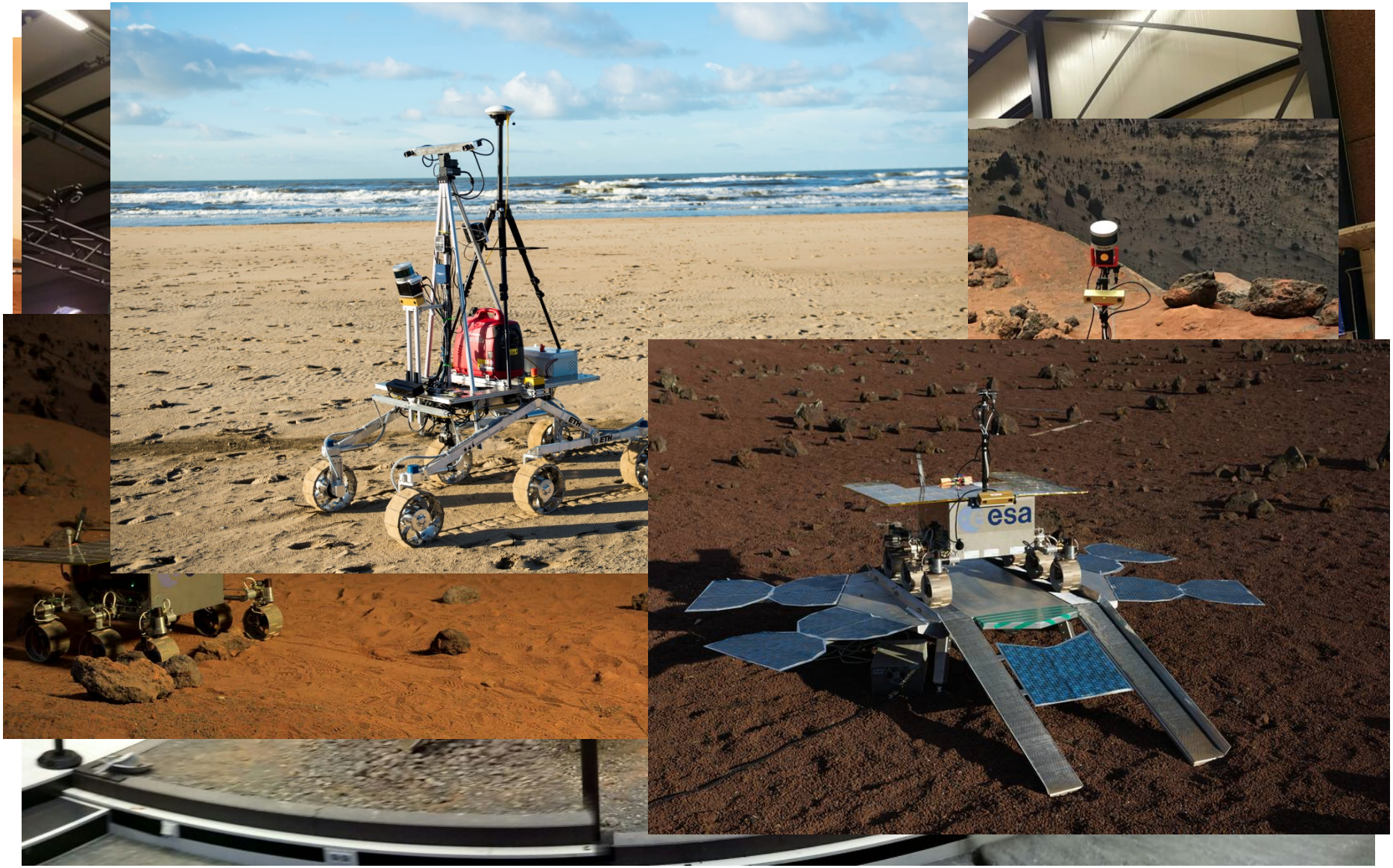
# Let me quickly introduce myself…



# Background

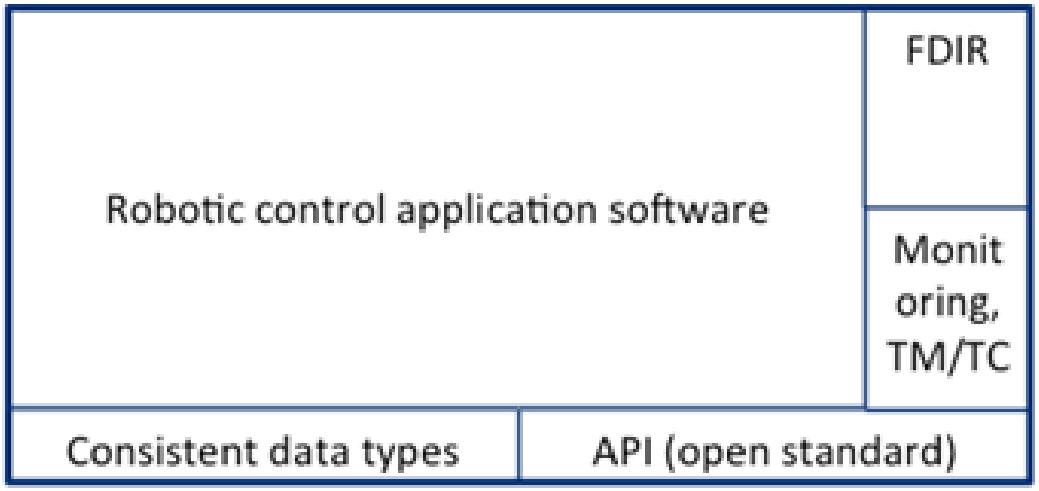
…In a nutshell, developing robotics onboard SW poses several challenges, especially due to their **criticality** and the complexity that grows with the level of **autonomy**.

The use of formal methods is increasingly popular (i.e. necessary), and **Model-Based** techniques are being developed/studied in many robotics applications.

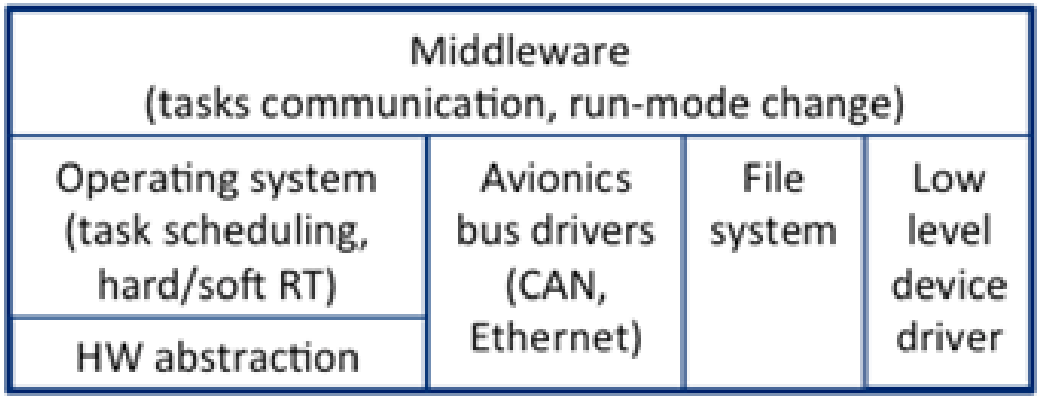
# What is SARGON

## SPACE AUTOMATION & ROBOTICS GENERAL CONTROLLER

Activity to design a Robot Control Operating Software (RCOS) with special care on RAMS requirements and re-usability at different implementation phases.




Generic schematic representation of a RCOS.



# SARGON – Why

## To Reduce the Gaps between different Robotics Developments

- In Space, ExoMars or European Robotic Arm (ERA) require significant software engineering effort compared to other satellite missions, due to complexity and low heritage.
  SW tools used are highly customized -> very little percentage of this software development, validation and verification effort becomes re-usable.

- In Industry, commercial closed source solutions customized for their HW/products. Reliable, but far from getting to standardization, being portable or achieving inter-operation.

- In Academia, the trend is to use robotics SW frameworks (ROS, Rock, …), which allow fast prototyping and testing for R&D activities but far from RAMS-compliant -> Transitions to reliable applications require extensive recoding.

## TASTE – A MODEL-DRIVEN APPROACH

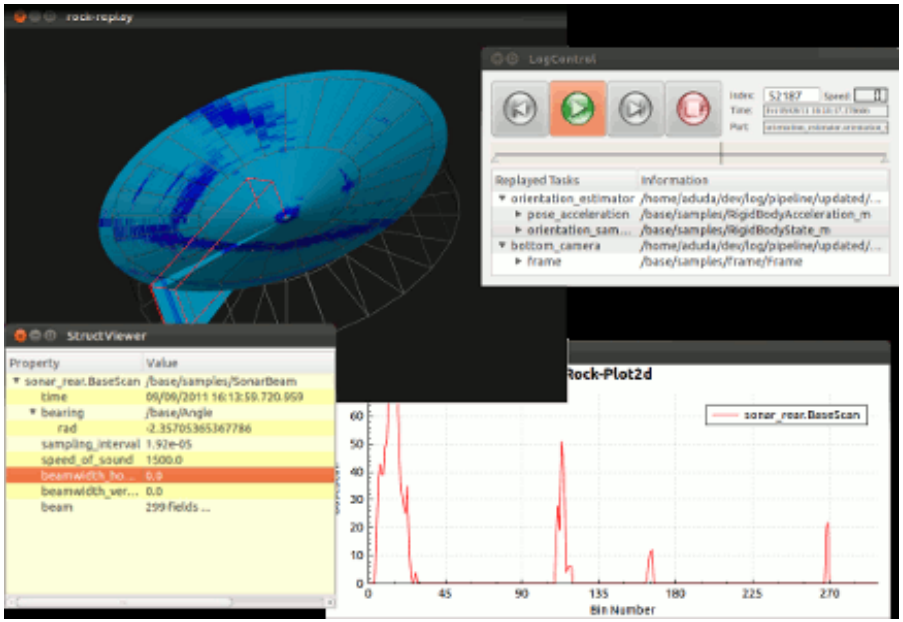
- TASTE provides a **model-driven approach** for the development of **reusable** and **RAMS**-compliant on-board software.

- SARGON focuses on the analysis and **definition of requirements for an RCOS** and on identifying the building blocks to **complement the current TASTE** implementation for covering all needed RCOS functionalities.

- The aim of this TASTE RCOS is to be the **base of future European space robotics applications**, and in this context SARGON is a first step in that direction.

# ADAPTATIONS TO TASTE TO MAKE IT ROBOTICS FRIENDLY

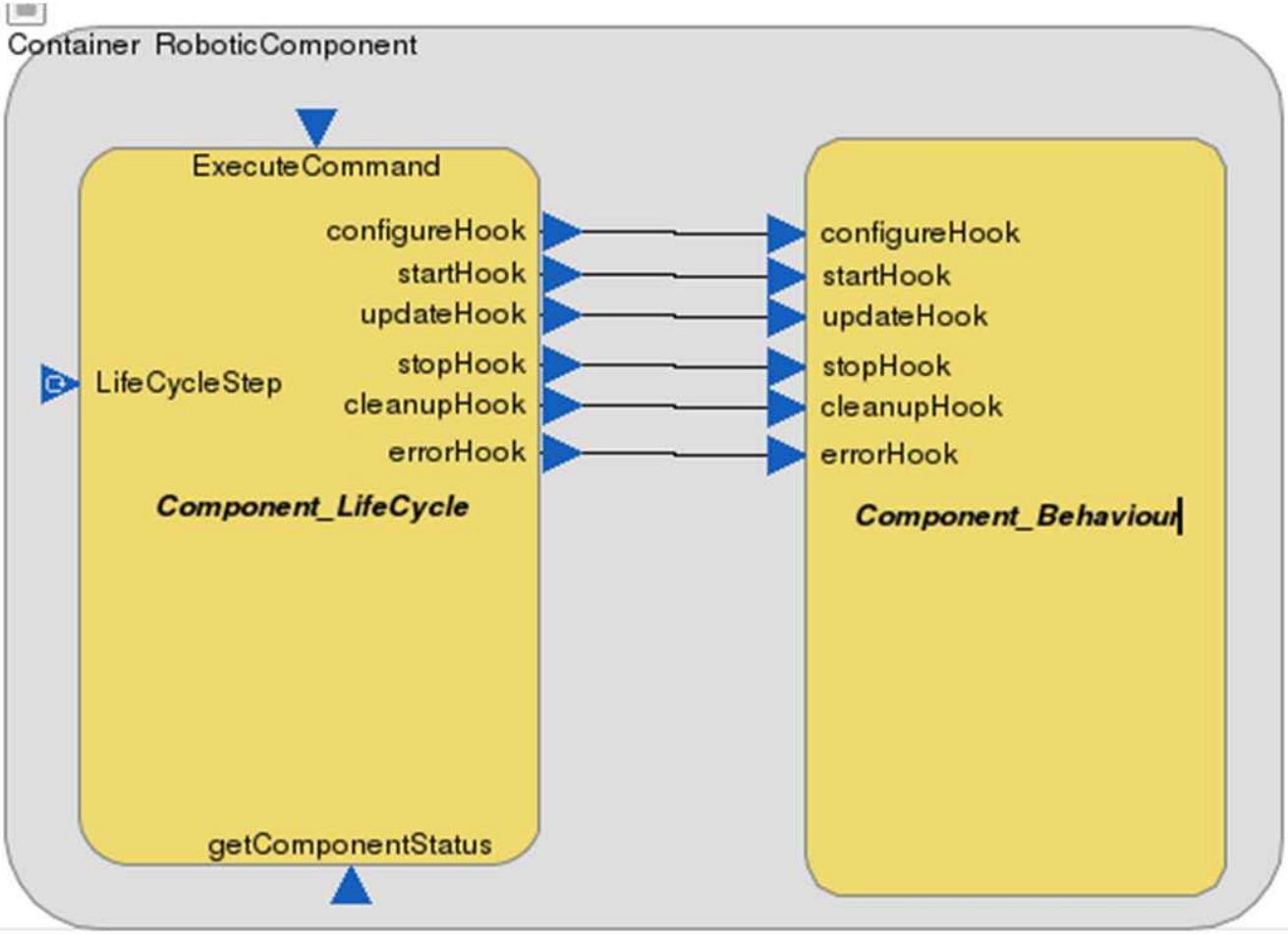
- Importing of legacy code, C/C++ libraries
- Rock2Taste & Taste2Rock:
  Transformations between Platform Independent Models and Platform Dependent Implementations.
- Robotics Data types into ASN.1
- Monitoring & Control of 2D & 3D data:
  - Robot Data Visualization (Vizkit)
- Robot kinematics modelling (URDF)
- Robotics Simulator (Mars)
- Component Life-Cycle:
  Re-usable skeleton implementing the component run-mode state-machine.



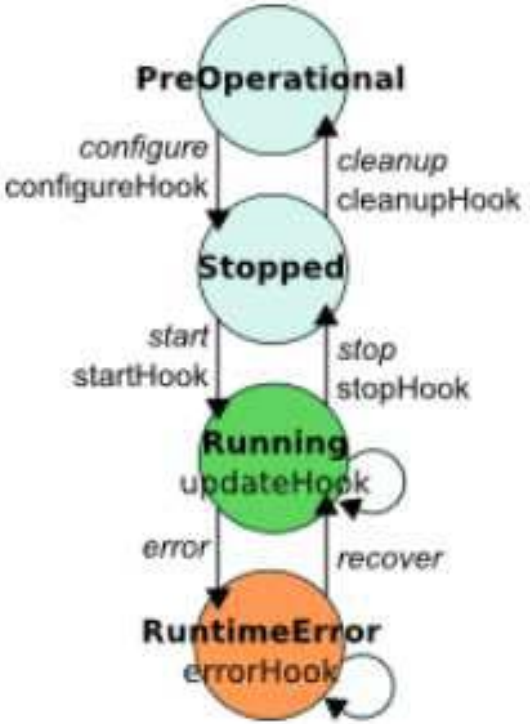

Monitoring of 2D & 3D data in Vizkit

# Component Life-Cycle

## Interface-View of the Component Life-Cycle



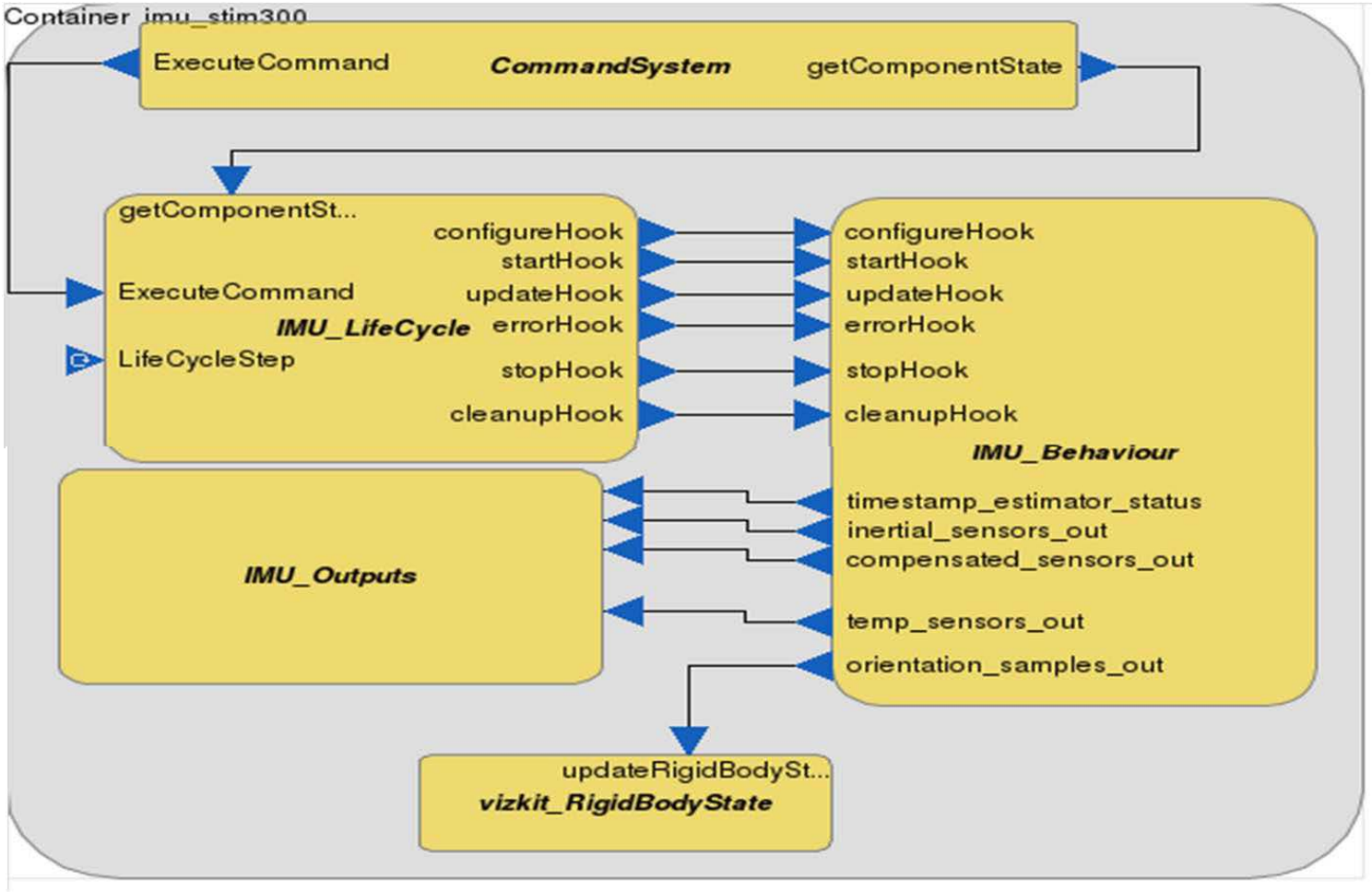

Re-usable Taste Generic Robotic Component




Rock Component State-Machine Representation

# Robotics Application using TASTE – IMU Demo

MODEL-BASED APPROACHES ALLOWED FOR FAST TRANSFORMATION AND DEVELOPMENT OF PROTOTYPE IMPLEMENTATION. DEMO WITH IMU



# Planned Work

## Two Prototype Implementations

As Taste gets robotics-complemented we plan to design and deploy two prototype implementations, addressing different levels of RAMS requirements (form lower to higher constrains). Both will be using the ExoTeR lab rover platform.

- Lab-quality:
  - Target HW: PC104 embedded computer (Intel x86) running Ubuntu.
  - Features to implement: Locomotion, stereo camera acquisition and telemetry visualization.

- Space-quality:
  - Target HW: GR712RC Leon3 board running RTEMS.
  - Features to implement: Locomotion and telemetry visualization.

# CONCLUSION

# Programmatic

SARGON is an activity funded by the ESA Basic **Technology Research Programme** (TRP). The activity was started in January 2016 and is planned to conclude in summer 2017.

While the activity is ongoing, it has already been successful in securing a continuation. The **EC H2020** programme, within the Strategic Research Cluster in Space Robotics, has awarded an operational grant to the **ESROCOS** team for the further development of **SARGON**.

# You may ask questions now ?

THANKS FOR YOUR ATTENTION!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