CENTRE NATIONAL D'ETUDES SPATIALES

CADMOS NATIONAL

Direction du Numérique de l'exploitation et des Opérations
Sous-Direction Science et Exploration
Projet Vols Habités en Développement (CADMOS DEV)

Ref. : -

FLUIDICS (FLUID DYNAMICS IN SPACE) SLOSH4AOCS EXECUTIVE SUMMARY REPORT

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INDEX SHEET

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FLUIDICS (FLUId DynamICs in Space) SLOSH4AOCS

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GLOSSARY AND LIST OF TBC AND TBD ITEMS

CADMOS	Centre d'Aide au Développement des activités en Micropesanteur et des Opérations Spatiales
FLUIDICS	FLUId DynamICs in Space
i.e.	id est (= that is)
N/A	Not Applicable

List of TBC items:

List of TBD items:

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1.   OVERVIEW

This document is the executive summary report of ISS SLOSH EXPERIMENT 4 AOCS SYSTEMS" - EXPRO

The detailed documentation has been delivered in document [1] and [4]

Dedicated excitation sequence has been designed and implemented on bord during FLUIDICS sessions #2 and #8. Two data packages have been delivered as results of these two successful sessions

This document is the achievement of tasks define in ESA RFP/3-16378/19/NL/CRS/hh document "Fluidics II Sustaining Engineering "ISS Slosh Experiment 4 AOCS Systems"

Paolo Nespoli during session Fluidics #2

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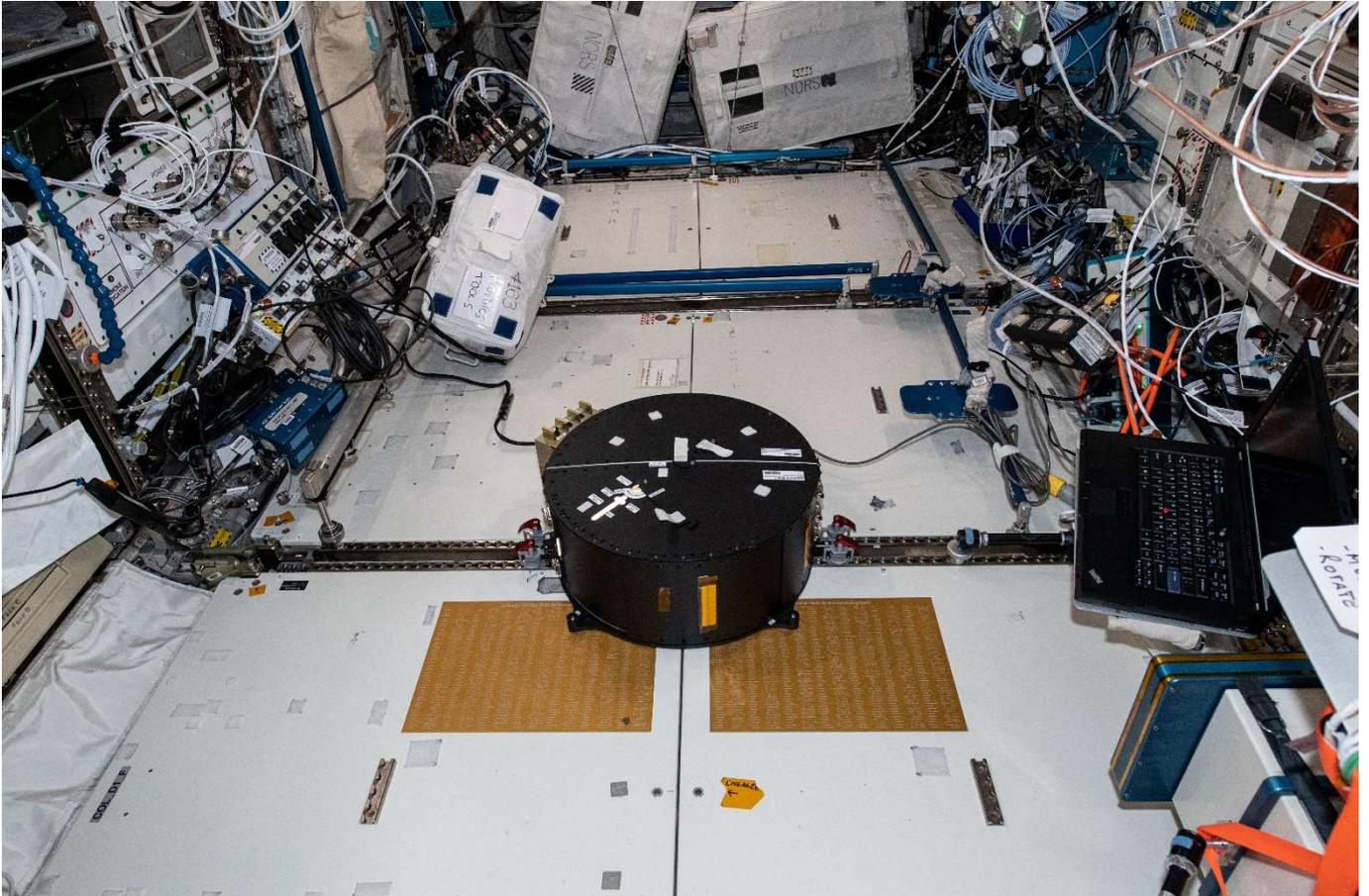
Fluidics installed on Columbus deck

2.   DOCUMENTATION

2.1.   REFERENCE DOCUMENTS

N/A

2.2.   APPLICABLE DOCUMENTS

[1] Fluidics data processing - 3/4/2020 - CAD-NT-CP1007-6342-CNS

[2] Fluidics II Sustaining Engineering "ISS Slosh Experiment 4 AOCS Systems" ESA RFP/3-16378/19/NL/CRS/hh

[3] Fluidics II Sustaining Engineering "ISS Slosh Experiment 4 AOCS Systems" CNES proposal Ref : DAJ/AR/NO-2019.0016749

[4] FLUIDICS (FLUID DYNAMICS IN SPACE) SLOSH4AOCS Final Report - CAD-NT-CP1007-7402-CNS 01/00…..

3.   EXECUTIVE SUMMARY

3.1.   BACKGROUND

The objective of Fluidics experiment is in the first instance to validate the behavior of fluids predicted by computational tools and a priori models in a controlled long duration microgravity environment. From the technological perspective objective of the experiment addresses issues relative to the slosh of fluids during specific spacecraft and satellites maneuvers. The more fundamental objective aims at observing capillary wave turbulence on the surface of a fluid layer in a low-gravity environment in order to be able to correct the physics assumed in computational tools.

CNES/CADMOS has tuned technical objectives in order to provide operational data of previous FLUIDICS operations, immediate use of Fluidics with dedicated scenario corresponding to ESA requirements.
The control strategy known as "FEEDFORWARD" which consists of pre-filtering the motor control in order to avoid exciting the motor has been implemented and results are supposed to demonstrate the capability to design satellite manoeuvers avoiding fluid sloshing modes excitation.
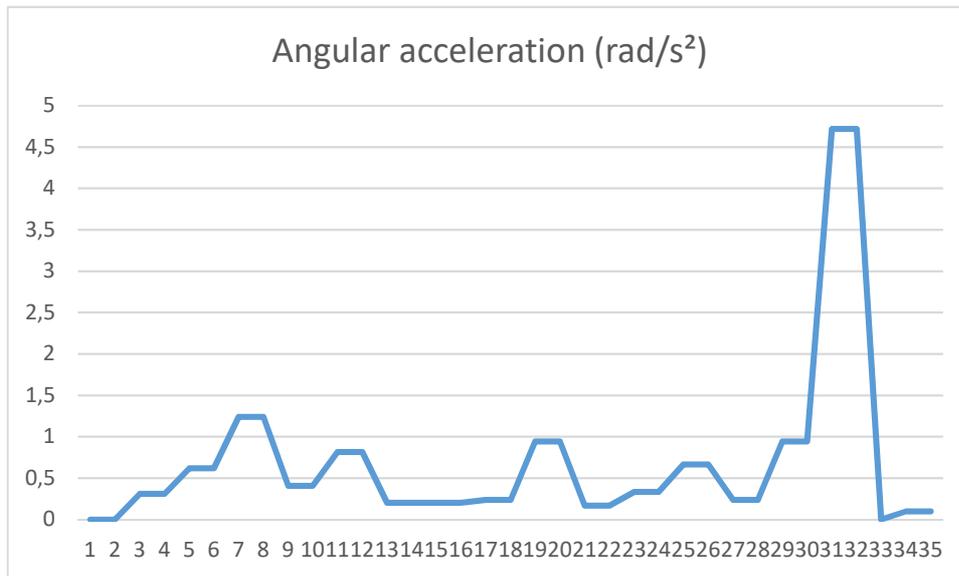

Feedforward profile session #2

After retrieving the data acquired during the session #2 executed by Paolo Nespoli a dedicated tool was developed in cooperation with Airbus Toulouse to process the data in order to obtain physical data (forces and torques) from the raw data recorded on board. The corresponding video data ware also extracted from the contents of the disc lowered by a freighter in 2018 and delivered to Airbus
The associated documentation is also part of the delivery. This document explains the use of the tool, the input data, the physical justification of the treatments performed and the resulting physical data.

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The first encouraging results of Feedforward session drove the design of new dedicated profiles by Airbus Friedrichshafen. The new experience activation profiles were defined in order to refine the results obtained during session #2 and to study new fluidic phenomena.

The data resulting from this session #8 can be processed directly following the same process as that established by the previous task.

Profile 1
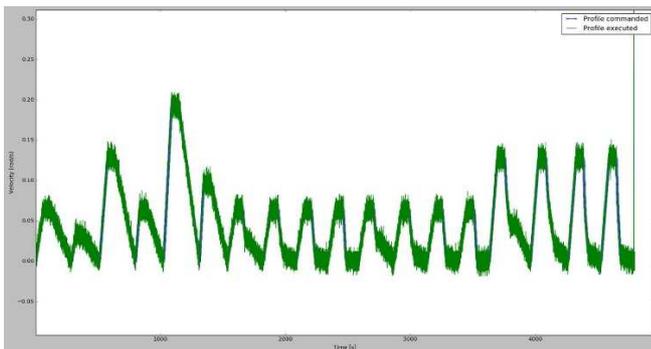
Profile 2
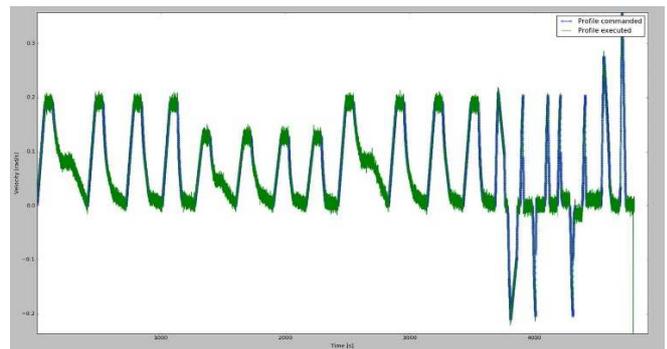
Session #8 was dedicated to the "SLOS4AOCS" experiment. Two profiles were studied by Airbus Friedrichshafen (Jens Levenhagen). The conversion to the proposed script was done by CADMOS and Airbus DS to deal with the physical limitation of Fluidics instrument and format of files. As for the session #2 integration, test and operational procedures were performed by CADMOS team.

These two profiles were implemented during session #8 with a repetition of the firs one during the two first run and execution of the second one in a dedicated run:

- *run 1 : Tank 1 feedforward A – profile 1*
- *run 2 : Tank 1 feedforward B – profile 1*
- *run 3 : Tank 5 (baffle) – profile 2*

The shape of these profiles is based on the existing possibilities of the material while seeking to explore the possible domain with excitations in position, speed and acceleration variable.

The scientific data processing will be done by Airbus Friedrichshafen (Jens Levenhagen) using data recorded by force sensors and video files from the camera.

amplitudes comparable to what one would expect.

However, post-processing does allow the efforts of the fluid to be obtained. The curves obtained are consistent with the physical phenomena involved (amplitudes, signs), which gives a satisfactory level of confidence in the results.

Scientific data processing and analysis will be performed by Airbus Friedrichshafen.