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| System Identification within PF,proposal |
| |  |  |  | | --- | --- | --- | | Date, Time: | 02.03.2018, 11:00 – 12:00 o’clock | | | Location: | Koper Group AG, Binzstrasse 31, 8620 Wetzikon | | | Participants: | Alejandro Valverde (Trainee Rotorheads, Kopter) | Nilesh Chaudhari (Team Leader Flight Physics) | |  | Kurt Kolb (Chief Engineer Aircraft Systems, Kopter) | Fabio Riccardi (Flight Physics Analysis Engineer, Kopter) | |  | Sophie Robinson (Flight Physics Analysis Engineer, Kopter) | Alessandro Masi (Flight Physics Analysis Engineer, Amaris International Consulting Company) | |  |  |  | |  |  |  | | Distribution List: | Participants |  | |

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# Introduction

The aim of the meeting was to discuss the proposed project of implementing Aircraft System Identification (SID) methodologies as a tool for helicopter dynamic modelling.

The complete proposal could be found attached in [App 1].

# Discussion

A summary of the discussion during the meeting is presented below:

* Mr. Nilesh Chaudhari raised awareness of the necessity of involving third parties, i.e.: Chief of Avionics and Chief Flight Test Engineers, for the correct consecution of the project. They would be required to be involved in a possible future formal proposal of the project.  
    
  He pointed out that the main interest of the implementation of SID, from the point of view of Flight Physics department, would be the possibility of performing a consistent and fast validation of the developed helicopter dynamic model. This requirement is not currently properly fulfilled by the model developed using Flightlab analysis software.
* Mr. Fabio Riccardi remarked that the introduction of system identification methods would require the pilots to perform dedicated manoeuvres, and high quality flight test data. Also, he pointed out that the utilization of the so called “grey approach” would require the elaboration of a mathematical model of the particular helicopter dynamics under investigation, prior the utilization of SID approaches. He described that the SID methodology could be tested on a linearized Flightlab model generated at various flight conditions and W/CG configurations. This model would be obtained from the simpliest configuration achievable from Flightlab which is the one that considers MR, TR and fuselage to be rigid bodies.
* Mr. Alejandro Valverde had included in this presentation that the use of SID methods could be applicable to the assessment of the helicopter handling qualities and the resolution of related issues that may appear, for example, as a result of the P3 flight envelope expansion. At this point, Mr. Alessandro Masi and Mr. Fabio Riccardi doubted on what it was stated by Mr. Alejandro Valverde. They remarked that the utilization of SID analysis to address handling qualities issues and the impact of modifications on the helicopter systems would be an extremely difficult task and no success is ensured.   
    
  They, however, remarked that the usage of SID as a tool for the development of a Flight Control System (FCS) and a Simulator is, in fact, the right approach.
* Mr. Alessandro Masi insisted on the benefits of the application of SID within the development of civil rotorcrafts, based on his previous professional experience.   
    
  He also pointed out that the involvement of the pilots is a crucial aspect as they are required to perform complex manoeuvres. At this point, Mr. Fabio Riccardi remarked that the definition of the right manoeuvres that would excite the aimed helicopter dynamics is another critical point. This definition could be constructed using the available analytical model (Flightlab) to simulate identification manoeuvres, and hence use the model in/out to feed the identification routine, in order to tune properly the input excitation sequences (3-2-1-1, doublets, frequency sweep) to be used in flight experiments. Anyhow, this would strictly require the development of a Stability Augmentation System (SAS) in the Flightlab model.  
    
  In relation to the utilization of SID methods for P3 flights in summer, Mr. Alessandro Masi explained that, after discussed and agreed with Flight test team and pilots, some fractions of the planned tests could be finalized at collecting data for this scope. In the meantime, a proper tool could be developed in order to be ready and usable as soon as suitable flight test data will be available.
* Dr. Robinson remarked the need of incorporating SID methods in parallel with current analysis tools that are used as part of Flight Physics operations. SID should not replace any existing tool but extend its capabilities. Mr. Alessandro Masi mentioned here the possibility of incorporating SID methods as part of a more complex model in which Flightlab software would also be present.  
    
  Dr. Robinson also mentioned the need to justify to our external and internal auditors the use of SID methodologies as a valid new approach which may be philosophically quite different to the approach that is now in use.
* Mr. Kurt Kolb remarked the company need of developing a state-of-the-art helicopter with the inclusion of state-of-the-art analysis methods like the one presented. This will allow Kopter Group AG to present a product to the market, the SH09, that will outstand over its competitors.

# Conclusion

The participants agreed on the following points as a result of the discussion:

* The inclusion of SID methodologies is indeed a really interesting proposal and it was evaluated as something that the company would need to incorporate at some point. The following fields of application were highlighted:
  + Flight Control System (FCS) development
  + Helicopter Simulator development
* The following interesting characteristics of the SID method were agreed:
  + SID would provide a valid model of the helicopter dynamics provided suitable flight data and dedicated test points in the Flight Test campaign
  + The SID approach would simplify model validation tasks
* The tasks related to the development of the project would need to be incorporated within Flight Physics Department operations
* The required resources for the project consecution would be relatively low
* Mr. Fabio Riccardi would be able to provide black-box identification tools (PI-MOESP, PBSID) developed during his PhD, to be used in parallel to the grey-box approach via SIDPAC. In this case, he would be available to contact his PhD advisor, Prof. Marco Lovera (Politecnico Milano), who has been involved for several years as consultant and scientific advisor on projects regarding identification in Leonardo.
* The hypothetic realization of the project would necessarily affect third parties of which there were no representatives during the meeting. The affected disciplines were identified to be Flight Test Engineering, Flight Test Pilots and Avionics Department, at least. The need to get them involved in the formalization of the proposal was agreed.

All the Participants agreed that, upon consecution of the action items described in Section 4, there will be another meeting that could be used to set next steps for the escalation of the proposal to a higher hierarchy level within Kopter Group AG Design Organization.

# Action list

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| No | Action description | Responsible | Due date |
| 1 | Preparation of detailed list of concerns regarding the implementation of SID methodologies within Flight Physics and Flight Testing activities | Flight Physics department | - |
| 2 | Coordinate the involvement of third parties such as Avionics Team and Flight Test Engineers | Alejandro Valverde | - |

# Appendices

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| Item | File name |
| 1. Project proposal presentation | System Identification to support Flight Test activities - proposal.pptx |

# Revisions

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| --- | --- | --- | --- |
| Rev | Version | Comment | Name |
| A | 00 | Initial release | Alejandro Valverde |

Table 1: Revisions