ECOLE CENTRALE DE NANTES

ASSESSMENT OF LOADS INDUCED ON MARINE STRUCTURES BY EXTREME WAVE EVENTS

Experimental investigation of the high speed ditching of Helicopter

SECOND YEAR PROGRESS ASSESSMENT

Author
Mohamad Abu Ubaidah Amir Abu Zarim

Supervisors
Dr. Benjamin Bouscasse
Dr. David Le Touze
Dr. Bertrand Alessandrini

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1 Summary

This report summarizes my Ph.D. research progress from July 2018 to July 2019. This time period corresponds to part of the second year of my Ph.D. candidacy. As stated in my first report, the goal of my Ph.D. research is to study of loads induced on marine structures by extreme wave events. However, this lead to the study of helicopter ditching in extreme condition. My research methodology is experimental and consists of three phases, two of which have been completed as of March 2019. The first phase consisted of gathering a suite of real benchmark on non-linear wave in wave tank in Ecole Centrale de Nantes (ECN). This is continuation of the previous experiment, known as BV wave, where the wave condition are set to suited the Bureau Veritas (BV) test requirement. The second phase consisted of experimental on helicopter ditching test, also conducted in ECN wave basin. Attached with this report is a draft of the experiment report entitled "Helicopter Ditching: Experimental investigation of the high speed ditching of Helicopter".

2 Background of the PhD

My Ph.D. through Malaysian offset program with specific agreement with ECN. The duration of this scholarship is 3 years without extension. I have been placed at Laboratory in Hydrodynamics, Energetics & Atmospheric Environment (LHEEA). The timeline of the Ph.D. is best to present as in Figure 1.

My Ph.D. officially starting on November 2017. At the beginning, I have a difficulties to suit well with what Lab doing, particularly with a programming language. Thus, for the first 6 months, under supervisors consent, I am undergone a course with students M2 Hydrodynamics for Ocean Engineering (Marine Technology Course). I officially start a proper PhD on July 2018, after the first CSI evaluation. On September 2018, I started to spend my time at laboratory to run experiment for BV wave. The data from this experiment is crucial for scaling the wave that later has been used for Increased Safety & Robust Certification for ditching of Aircrafts & Helicopters (SARAH) campaign.

2.1 Determination of the PhD direction

The original subject was "Assessment of loads induced on marine structures by extreme wave events ". This title relies to safety of people during storms and extreme events. Then as SARAH project about safety of people during ditching in extreme waves started, we decide together with my supervisors to specify the subject towards experimental helicopter ditching. Hence, new title is therefore "Experimental investigation of the high speed ditching of Helicopter ".

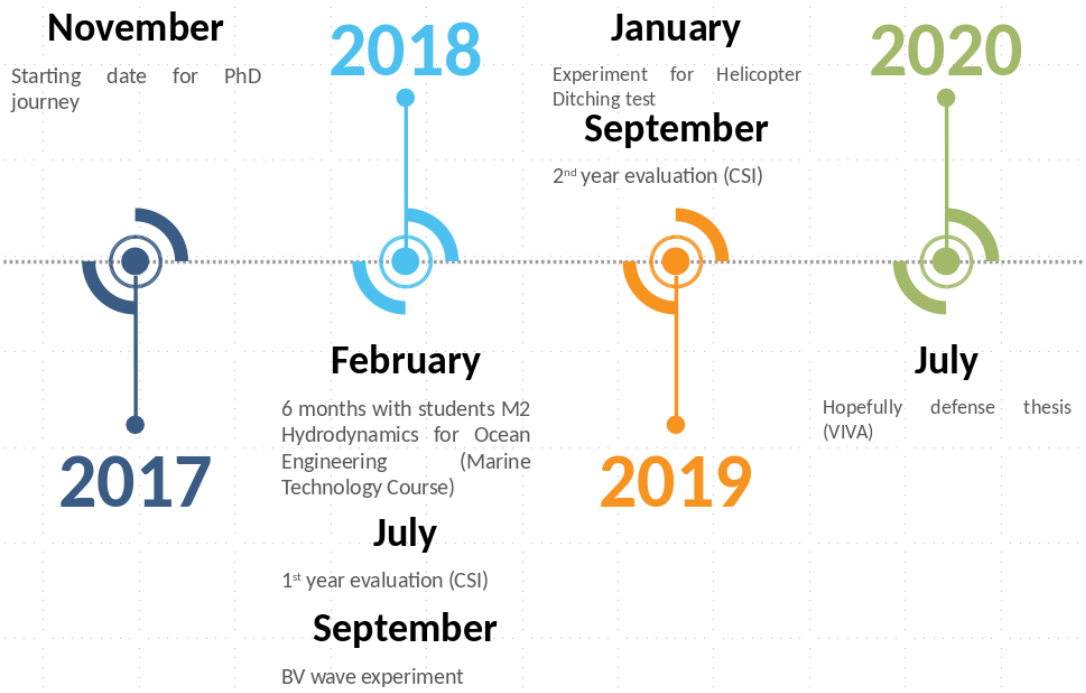

Figure 1: Timeline Ph.D. journey.

3 Research description

This campaign is carried out under research of SARAH (Increased Safety & Robust Certification for ditching,of Aircrafts & Helicopters). SARAH project is a Horizon 2020 collaborative project, aiming at establishing novel holistic, simulation-based approaches to the analysis of aircraft and helicopter ditching. The project,is coordinated by IBK-Innovation and its consortium that brings together aircraft manufacturers, software developers, research organizations and universities to form a strong team covering the required expertise in aircraft design, numerical methods and simulation, ditching analysis and experimental testing to achieve the project objectives. The Ecole Centrale de Nantes (ECN) are responsible to conduct a campaign for Helicopter Ditching program. The development of the campaign in ECN including design, numerical and experimental campaign. The results from this campaign are important for SARAH project.

3.1 Research Overview

Aircraft and helicopter often travel above open waters and thus have to follow regulations ensuring a safe water landing under emergency conditions, also referred as ditching. This is particularly true for helicopters as they are commonly used to support marine task, for instance serving offshore platform. Ditching is related with crash,

but with distinctive features. The specific aspects are hydrodynamics slamming loads, complex hydromechanics at very large forward speeds, as well as interaction of multiphase fluid dynamics (air, water, and vapor phases). Additionally, helicopters are provided with Emergency Floating Systems (EFS), which are inflatable structures connected to the fuselages with girths.

The campaign requires identification of favorable approach conditions in which limited engineering experience is available with regards to ditching. In addition, understanding the physics on the hydrodynamics load mechanism is critical for verification of full aircraft configurations, and consequently the test must be as similar as possible to a real case. The experiment is designed in the framework of the Horizon 2020 SARAH project, aiming at establishing novel holistic, simulation-based approaches to the analysis of aircraft and helicopter ditching.

The tests are performed at the ocean wave tank of Ecole Centrale de Nantes both in calm water and in waves with a scaling of 1:3.4. At model scale, the helicopter built in aluminium weighs around 338 kg, with a maximum horizontal velocity at impact around 8 m/s and a maximum wave height tested of 0.94 m. Measurements are performed through 3 piezoelectric load cells under the fuselage, placed in the front, the middle and the back of the cabin. Additional load cells are dedicated to measure the loads given by the floats on the sponsons and on the cabin, and on the girths linking the floats to the fuselage. The methodology of the campaign is expected to provide a more robust and reliable database for helicopters, based on a unique methodology and technologies. It can be used as a benchmark to analyze and optimize approach, landing and impact during water landing scenarios.

3.2 Research Aims

The objectives of this study is to investigate the phenomena during the impact on high speed water entry in order to enhance the fundamental understanding. The findings also expected to improve the capability of future numerical simulations within aircraft design and certification. The state of art of intended contributions are mainly:

a. Investigate physical phenomena based on robust and reliable solutions for helicopters experimental data from novel methodology campaign of helicopter ditching tests.

b. Develop the dataset bank. This can be use as a benchmark to analyze and optimize approach, landing and impact during water landing scenarios. Based on attained knowledge, the crucial information analyze from the experiment are interpreted into a bank of dataset. The information from dataset are relevance for improvement to be taken into account for the numerical modeling.

c. An improved understanding of environmental phenomena, hoping to contribute to protect the aircraft/ helicopter by analyzing wave effects, ground effects and handling qualities; in order to increase the safety of helicopters in ditching/ floatation

situations.

d. To provide information of accurate loads to safely design and to improve aircraft and helicopter certification tools in a near future (under SARAH campaign as a whole).

4 Current Progress

The data are treated, analyzed and stored in a databank. The treated data is provided to permit a direct use for anyone interested by the acquired data. The specific or interest cases has been pinpoint, and further analysis still on going.

4.1 Conferences

At the moment, there are two conferences has been attended:

a. Assessment of Sea Surface Extreme Wave Events, The 5th Program of International Platform on Ocean Energy for Young Researcher 2018, Japan.

b. A new engineering systems for experimental testing of helicopter ditching: A methodology guide, The International Conference on Ocean, Engineering Technology and Environmental Sustainability 2019 (I-OCEANS 2019). (presenting on 5th August 2019, being awarded as best presenter).

4.2 Scientific and professional courses

Science Pour L'ingenieur (SPI) has set an obligatory for Ph.D. candidacy to complete 100 hours of training throughout the study. The requirement is breakdown into 40 hours for scientific and 60 hours for professional courses. Until this moment, I have completed 68 hours for professional courses and 38 hours for scientific courses. The courses is shown in Figure 2. According to SPI, the conference equivalent to 2 hours, and can be included as scientific. Thus, it is noted that courses for scientific (38 hours) can easily achieve 40 hours as the conference contribution hours are not included in the system yet.

jeudi 11 juillet 2019

Attestation de Formation

BIN ABU ZARIM MOHAMAD
2 rue de wassy

44100 NANTES

N° étudiant : 170875Y
Ecole Doctorale : Sciences pour l'Ingénieur
Etablissement : École Centrale Nantes (ECN)

Formation Professionnelle

Libellé court	Intitulé	Année d'acquisition	Nombre d'heures	Ects
ETH-EDD-01	Introduction à l'éthique de la recherche et à l'intégrité scientifique	2018	03:00	0.0
COM-PDNA-50	How to write and publish your paper	2018	18:00	0.0
LAN-PDNA-02	FLE (Français Langue Etrangère)	2018	18:00	0.0
ETH-EDD-02	Sensibilisation à l'éthique de la recherche et à l'intégrité scientifique	2018	03:00	0.0
	Cours de français pour débutant	2018	26:00	0.0
			68:00	0.0

Formation Scientifique

Libellé court	Intitulé	Année d'acquisition	Nombre d'heures	Ects
SPI_Collage	Collage des matériaux et structures	2017	12:00	0.0
DIS_SPI_04	Introduction to hydrodynamic stability	2018	12:00	0.0
DIS_SPI_09	Python pour les scientifiques	2018	10:00	0.0
DIS_SPI_SEM	SÉMINAIRE 2eme ANNÉE	2018	04:00	0.0
			38:00	0.0

Total général des formations

Nombre	Ects
106:00	0.0

Figure 2: Scientific and Professional courses.

5 Future Work

With the results of experimental tests, they are a few fundamentals and questions arising and must be answer. The questions regarding the physical phenomena, a small differences between the floater types, and small irregularities on the signal. Other than that, wrap up on the thesis and produce one or two more publications either in conference or journal.