



Jerk JIP proposal

Ship motion affects comfort of passengers. Although ISO2631-1:1997 offers guidelines for acceptable acceleration levels, these guidelines assume continuous vibration, characterised by relatively low levels of jerk, i.e. the time derivative of acceleration. New generations of ships, however, are causing irregular series of distinct events characterised by relatively high jerk levels. In the recent past, the maritime industry showed a renewed interest in properly understanding the implications of these jerk events on the comfort of passengers onboard vessels. However, detailed knowledge of the physics of the phenomenon and of the sensitivity to it of the human body is lacking, as do univocal acceptability criteria of jerk levels perceived onboard ships. MARIN and TNO will collaborate and share their expertise to study in detail how jerk is experienced onboard vessels by passengers and to understand if jerk represents indeed a degradation of the comfort level. In this document a proposal for a Joint Industry Project is made.



Objectives

Jerk is suspected to affect different aspects of comfort (e.g. postural stability, fatigue, seasickness, safety...). Of these aspects, seasickness seems to be least dependent on jerk (ISO2631-1:1997), while posture definitely is. Moreover, postural stability is the one that can be observed and studied objectively. Besides being an effect that can be monitored and measured, it is also the one requiring the shortest exposure time to an external excitation to determine the reaction of the human body. For this reason, a deeper understanding of the effect of jerk on postural stability is the first target of this research proposal. Dedicated tests of participants on a moving platform are considered the most efficient way forward to define jerk limits above which postural stability might be compromised.

Once the jerk thresholds above which the human equilibrium is compromised are known, a proper methodology of analysis of experimental signals becomes an important part of the problem. The effect of jerk is visible at high frequencies, where experimental data are affected by instrumentation noise. Proper filtering, sufficient sampling frequency and a deeper knowledge of the human sensitivity to jerk in terms of postural stability are fundamental ingredients to extrapolate useful information from experimental data. The second target of this research proposal is to suggest an analysis methodology of signals.

Time schedule

The project is envisaged to run for about 1.5 years. The approximate time frame for the main milestones is as follows:

- Gathering of participants, collection of feedbacks and final project proposal: Q3 – Q4 2019.
- Project kick-off: Q1 2020.
- Tests on moving platform (execution and analysis): Q2 to Q3 2020.
- Definition of an analysis strategy for jerk: Q1 to Q3 2020.
- Presentation of final results and reporting: Q4 2020 – Q1 2021.



Interested parties

The proposed Joint Industry Project is open for all interested parties. In view of the challenges to be addressed, the project is expected to be of most interest to:

- Passenger vessel designers (yachts, cruises, ferries,...)
- Working vessels where performances of the workers are of importance (navy, research vessels, maintenance vessels,...)
- Shipyards
- Ship owners
- Classification societies
- Roll stabilisers providers

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Preliminary scope of work

Several parameters might play a role in postural stability: direction of the excitation, amplitude, frequency, posture of the person (e.g. standing, sitting, laying down, walking...), age, gender, Focusing on standing still people is considered a good starting point. The main interest will be in motions in the horizontal plane: longitudinal and transversal. A preliminary scope of work is proposed as follows:

- Experimental tests on standing volunteers on a moving platform. Each volunteer would be subjected to a random sequence of motions of the platform, characterised by jerk in different directions, frequencies and amplitudes. The target of these tests is to determine the limits above which people tend to lose balance in frontal and transversal direction. A number of 72 participants is considered as a minimum reliable statistical pool per condition studied. Cameras can be positioned to capture and count the moments in which there is a loss of balance. The loss of balance can also be 'measured' by evaluating the reaction forces due to a step of the volunteer.
- Develop an analysis methodology of experimental signals for jerk assessment onboard. In particular in this phase research the focus will be on:
 - Define proper measurement strategies in model scale and in full scale (e.g. which instruments, where to install them, how to determine the sampling frequency, ...);
 - Define proper filtering strategies in post processing;
 - Evaluation of the results with thresholds based on human responses.

Future developments

The proposed scope of work covers only partly the wide range of possible effects of jerk on passengers. Other aspects like fatigue and seasickness, although important and for sure demanding investigation and deeper knowledge, are at the moment not part of the presented scope. It is believed however that this proposal represents a fundamental starting point for gathering important knowledge on jerk. Upon sufficient interest and feedbacks from the industry, the presented scope of work can be extended to cover also different aspects. A more extended scope of work might be organised on a longer time frame and in terms of facultative work packages that each participant can decide to join.

Organisation

If a sufficient number of parties will show interest, a concrete scope of work proposal will be prepared and presented to all participants. Depending on the number and on the feedbacks of participants, the extension of the scope might vary and a list of work packages might be defined. Throughout the JIP, MARIN/TNO will act as Project Manager and Coordinator for all participants. The JIP itself will be managed in a democratic manner, with all participants having an equal vote. A set of project milestones will be defined. MARIN/TNO will organise several general meetings with the complete JIP group to discuss the results and set the overall course for the project. All participants will have exclusive access to the project deliverables through a confidential project server. The project findings will be kept confidential within the JIP group for a certain period of time as to be defined by the group. Any information will only be released into the public domain (e.g. conference papers) upon approval of the JIP group.