Comfort Evaluation S.A. Agulhas II

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Introduction

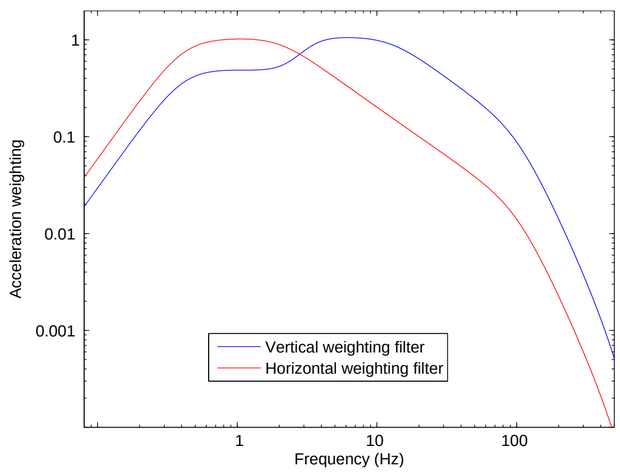
The comfort (with respect to vibration) aboard the S.A. Agulhas II is an important concern due the lengthy duration of the voyages, of up to 76 days.

Vibration levels where measured in two locations, the Bridge and the Operations Room, during the 2013-2014 Antarctic voyage. The whole body vibration discomfort was analysed according to BS ISO 2631-1:1997.

The assessment was based on the standing position assessment, as opposed to the seated position assessment used for analysis of seated occupants in cars, trains, aeroplanes, etc.

BS ISO 2631-1:1997

This standard specifies that for each measurement position a tri-axial measurement shall be made and a frequency weighting filter, which allow for the correlation of physical vibration measurements with the human response to vibration, shall be applied to the measured data. The figure below gives the frequency weighting as defined in the standard.



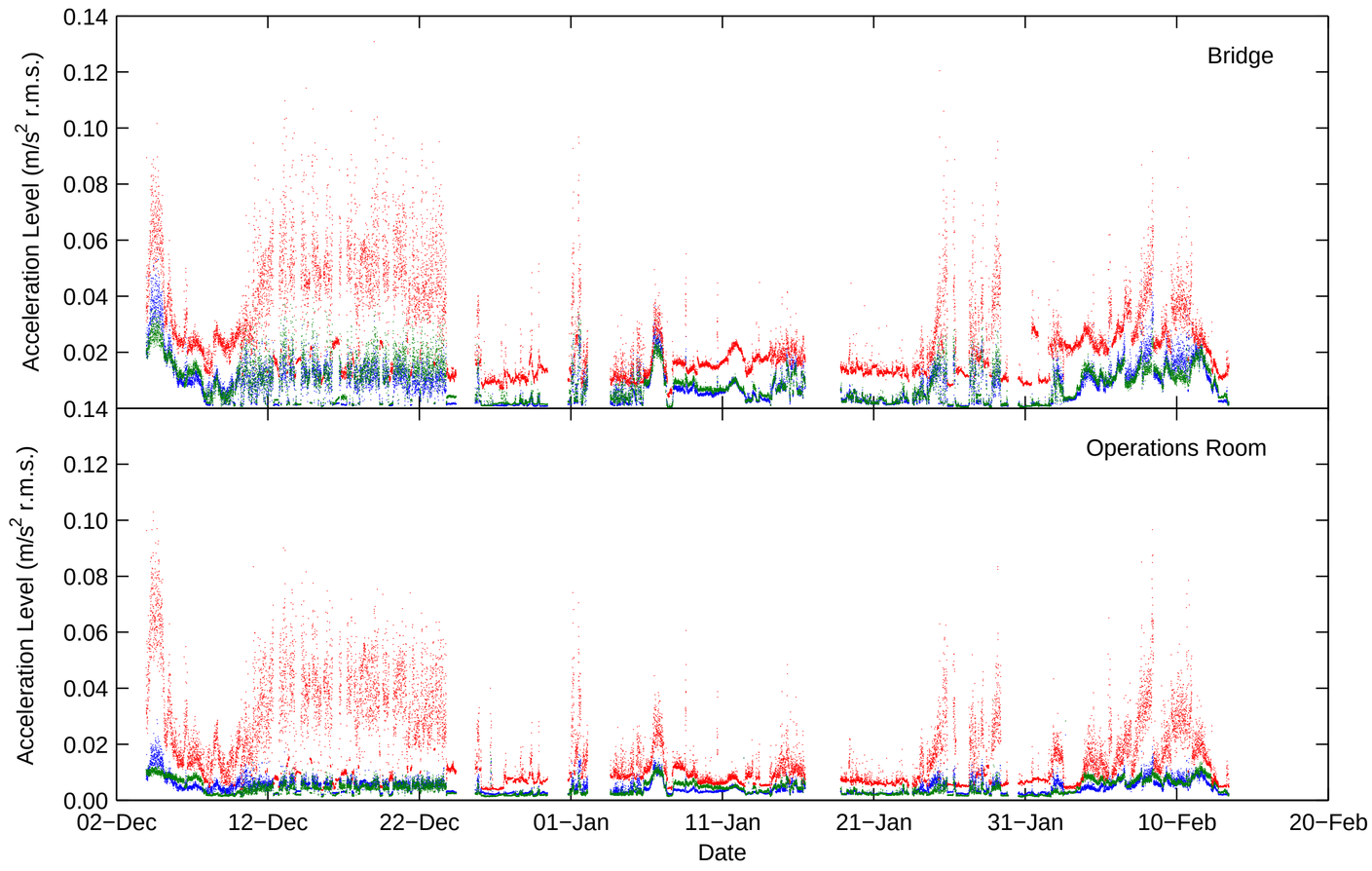
Various metrics for human comfort are defined in the standard, based on the frequency weighted data. These metrics are shown in the table below.

Metric	Application
Root-mean square (r.m.s) acceleration level	Analyse vibration that does not include shocks
Crest factor	Analyse if a vibration includes shocks. A suggested limit of 9 is provided in the standard (Less than 9 use r.m.s., above 9 use VDV).
Vibration dose value (VDV)	Analyse vibrations which include shocks
Overall-ride value	Combine the r.m.s. acceleration levels from the three orthogonal axis at a single measurement position.
Overall-Vibration Dose Value	Combine the VDV from the three orthogonal axis at a single measurement position.

The perceptibility of vibration is assessed by the maximum r.m.s. acceleration level of the three directions. The standard stipulates that the median perception threshold is $0.015ms^{-1}$.

Results - Antarctic Voyage (2013-2014)

The figure below shows the r.m.s acceleration levels for the duration of the voyage.



●: x (fore-aft); ●: y (port-starboard); ●: z (vertical)

- The frequency weighted acceleration levels are significantly greater in the Bridge than in the Operations Room. The maximum overall ride value for the duration of the voyage was measured as $0.12ms^{-2}$. The standard classifies this level of vibration as "not uncomfortable".
- According to the standard, the average (with respect to sensitivity to vibration) person aboard the S.A.Agulhas II during the Antarctic voyage would be aware of the vibration for 30% of the time in the Operations Room and 60% of the time in the Bridge.
- The crest factor showed that the vibration of the ship included many shocks, primarily due to wave slamming and ramming ice. The crest factors in the Bridge are above 9 for 13%, 21% and 21% of the measurements in the x (fore-aft), y (port-starboard) and z (vertical) direction respectively, while in the bridge the they are above the threshold for 9%, 10% and 33% of the measurement duration.

Future research

The BS ISO 2631-1:1997 standard does provide a guideline for the assessment of comfort, however the standard is intended for the analysis of vibrations without shocks. Since the vibration during the voyage often included shocks, the comfort needs to be further investigated by a laboratory study.

The Dynamic Seat Testing Facility (DSTF) at Stellenbosch University is a human rated hydraulic shaker that can recreate vertical vibration stimuli from vibration measurements. The purpose of this is that the vibrations aboard the S.A.Agulhas II can be recreated in the lab, and the human response to the vibration can be assessed.

This allows for various specific situations to be assessed, such as slamming in rough seas, ramming thick ice and pushing up against ice. For each of these situations the comfort and perceptibility of the vibration can be determined for a group of test subjects. The information gained from this study could benefit the standardisation organisations for future standards that include improved analysis method for vibrations which include shocks.

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