“Underwater Acoustics”

Program and Abstracts
(latest update: October 10, 2019)

25th DEGA Workshop ”Physical Acoustics,” Physikzentrum Bad Honnef, Germany, jointly organized by the Technical Committee “Physical Acoustics” of the German Acoustical Society (DEGA) and by the Working Group “Acoustics” of the German Physical Society (DPG)

Thursday, October 17, 2019

“medium-sized lecture hall” (in the Physikzentrum’s right side wing, 2nd floor)	
9:00 a.m.	**Welcome and organizational notes** Jens Prager, Anton Homm
9:10 a.m.	**1 On the efficient use of the hierarchical matrix BEM for target echo strength simulations** Boris Dilba, Marian Markiewicz, Otto von Estorff Novicos GmbH, Hamburg, Germany
9:50 a.m.	**2 Underwater noise simulations for the defense research vessel WFS Planet** Stefan Semrau DNV GL SE, Hamburg, Germany
10:30 a.m.	Coffee/tea break
11:00 a.m.	**3 Estimating the radiated underwater noise of seagoing platforms: The physics behind signal analytic approaches** Carsten Zerbs, Andreas Müller, Ingmar Pascher Müller-BBM, Hamburg, Germany
11:40 a.m.	**4 BURNSi – Benchmark Underwater Radiated Noise Simulations** Hans Hasenpflug Center for Ship Signature Management (CSSM), Kiel, Germany
12:20 p.m.	Lunch
1:30 p.m.	**Joint Meeting** of the Technical Committee “Physical Acoustics” of the German Acoustical Society (DEGA) and of the Working Group “Acoustics” of the German Physical Society (DPG)
2:00 p.m.	**5 Underwater acoustics – Experiments in a water tank** Arne Stoltenberg, Ingo Schäfer Bundeswehr Technical Center for Ships and Naval Weapons, Maritime Technology and Research (WTD 71), Kiel, Germany
2:40 p.m.	**6 Offshore pile driving noise: General setup and capability of state-of-the-art prediction models in 2D and 3D** Jonas von Pein, Stephan Lippert, Otto von Estorff Technical University Hamburg, Hamburg, Germany
3:20 p.m.	Coffee/tea break

3:50 p.m.	**7 Analysis of hydrophone calibration methods at low frequencies** Karol Listewnik Laboratory of Underwater Acoustic, Acoustics and Vibrations Laboratory, Central Office of Measures, Warsaw, Poland
4:30 p.m.	**8 Target Echo Strength – current and future look** David Nunn Defence Science and Technology Laboratory (Dstl), Porton Down, Salisbury, Wiltshire, UK
5:10 p.m.	**9 Challenges and future approach of radiated noise simulations for submarines** Norbert Hoevelmann, Ingo Martens E01 Signatures, Operating Unit Submarines, thyssenkrupp Marine Systems GmbH, Kiel, Germany
7:00 p.m.	Dinner in the Lichtenberg-Keller (basement of the Physikzentrum)

Friday, October 18, 2019

“medium-sized lecture hall” (in the Physikzentrum’s right side wing, 2nd floor)	
8:40 a.m.	**10 Active manipulation of acoustic signature** Delf Sachau[a], Hendrik Brüggemann[a], Anton Homm[b] [a]Helmut Schmidt University, University of the Federal Armed Forces, Hamburg, Germany, [b]Bundeswehr Technical Center for Ships and Naval Weapons, Maritime Technology and Research (WTD 71), Kiel, Germany
9:20 a.m.	**11 Hydroacoustic noise emission of hubless propellers** Matthias Witte, Max Hieke, Frank-Hendrik Wurm Institute of Turbomachinery (ITU), University of Rostock, Rostock, Germany
10:00 a.m.	Coffee/tea break
10:30 a.m.	**12 Performance of underwater acoustic channel for communication purposes** Iwona Kochańska, Jan Schmidt Department of Marine Electronic Systems, Faculty of Electronics, Telecommunications and Informatics, Gdańsk University of Technology, Gdańsk, Poland
11:10 a.m.	**13 Evaluation of range standards for underwater radiated noise measurements in beam aspect** Hans Hasenpflug[a], Layton Gilroy[b], Anton Homm[c], Stefan Schäl[c] [a]Defence Materiel Organisation (DMO), The Hague, Netherlands [b]Defence Research and Development Canada (DRDC), Atlantic Research Centre, Dartmouth, Nova Scotia, Canada [c]Bundeswehr Technical Center for Ships and Naval Weapons, Maritime Technology and Research (WTD 71), Kiel, Germany
11:50 a.m.	**Closing remarks and farewell** Jens Prager, Anton Homm
12:00 p.m.	Lunch (end of workshop)

Abstracts

1 On the efficient use of the hierarchical matrix BEM for target echo strength simulations

Boris Dilba, Marian Markiewicz, Otto von Estorff
Novicos GmbH, Hamburg, Germany

By means of the hierarchical matrix compression the complexity for the computational and memory requirements of the BEM are effectively reduced. However, for three-dimensional high frequency acoustic problems the effort grows with increasing frequency. In this contribution the application of different hierarchical matrix compression techniques for the target echo strength evaluation of a submarine is outlined. In addition to the discussion of the frequency dependent scaling behaviour of memory requirements and computational costs, efficient solution strategies are presented.

2 Underwater noise simulations for the defense research vessel WFS Planet

Stefan Semrau
DNV GL SE, Hamburg, Germany

Content of this presentation are the results of the study “Numerical waterborne noise prognosis including propeller cavitation, part 2.” Within this study DNV GL's own SEA-based underwater noise prognosis program was extended to include hydrodynamic effects of the propeller. The hydrodynamic calculations were carried out with the in-house calculation program NV571-2010, which works with the so-called “Tip-Vortex Index” in order to be able to estimate the influences of the propeller tip vortex. The methods used and the comparison with measurement data provided by the WTD71 are presented

5 Underwater acoustics – Experiments in a water tank

Arne Stoltenberg, Ingo Schäfer
Bundeswehr Technical Center for Ships and Naval Weapons, Maritime Technology and Research (WTD 71), Kiel, Germany

The possibilities and restrictions of experiments in the water tank of WTD 71 are shown. Two examples of experiments demonstrate the special features of this resource. One experiment aims at the validation of target strength calculations of a scaled steel body. The other experiment was intended to compare a ray tracing model as well as a target strength model with the occurring partial sound waves of an underwater obstacle. Both experiments were performed in close collaboration with the acoustic modelling working group of WTD 71.

6 Offshore pile driving noise: General setup and capability of state-of-the-art prediction models in 2D and 3D

Jonas von Pein, Stephan Lippert, Otto von Estorff
Technical University Hamburg, Hamburg, Germany

The foundations of offshore constructions, like, e.g., wind turbines, are normally attached to the sea bed by huge steel piles. Due to the high hammer energies that are needed to drive the piles into the soil, a considerable amount of noise is emitted into the water column. Subsequently, many countries have introduced legal restrictions for the underwater noise to protect the marine wildlife. Reliable and accurate prediction models to enable a prognosis of the noise levels prior to construction are therefore necessary to assess the noise emission and configure possible mitigation measures. Numerical prediction models have proven to be especially capable for this task, as they allow for a detailed consideration of the applied hammer technology, the pile geometry, possible noise mitigation measures as well as the specific propagation conditions in both water column and soil. This contribution explains the general setup of state-of-the-art numerical prediction models. Beside typical 2D models, also 3D approaches to consider distinct bathymetries, like, e.g., underwater canyons or shore lines, are addressed. Examples comparing predicted and measured noise levels are used to demonstrate the capability and additional value of numerical prediction models for offshore pile driving noise problems.

7 Analysis of hydrophone calibration methods at low frequencies

Karol Listewnik
Laboratory of Underwater Acoustic, Acoustics and Vibrations Laboratory, Central Office of Measures, Warsaw, Poland

The number of underwater acoustic recorders is growing, which, in accordance with Directive 2008/56/EC a framework for Community action in the field of marine environmental policy (Marine Strategy Framework Directive) are used to monitor underwater noise. The quality of the collected data is very important, therefore, the importance is attached to the calibration of hydrophone or hydroacoustic recorders and the maintenance of traceability as an unbroken chain of comparisons relating an instrument's measurements to a new standard IEC FDIS 60565-2:2019. The presentation shows an analysis made on the basis of a publication, which shows that the establishment of a new standard for the calibration of hydrophones in the low frequency range is the beginning of the road to knowing what are the values of the hydrophone parameters during measurements. The authors of the publication indicate that there are problems, e.g., with the time instability of the voltage sensitivity of the hydrophone, with the determination of its directivity, the impact of the housing on the measurements made and the vibroacoustic energy transferred from the sea floor on the underwater noise recorder structure. The presentation is an attempt to organize this knowledge.

8 Target Echo Strength – current and future look

David Nunn
Defence Science and Technology Laboratory (Dstl), Porton Down, Salisbury, Wiltshire, UK

Target Echo Strength (TES) has been around for as long as humans have used active sonar. You could argue a lot longer than that, but we were unaware of it. Every object under the water has a TES, but this is dependent on many factors. This presentation aims to look at the various reasons TES has mattered and why it still matters. An attempt will be made to consider the history of TES, its development, progress and possible future, particularly from a UK perspective. It will also ask some difficult questions as to how we should approach understanding TES, whether that be by measurement or modelling.

10 Active manipulation of acoustic signature

Delf Sachau[a], Hendrik Brüggemann[a], Anton Homm[b]

[a]Helmut Schmidt University, University of the Federal Armed Forces, Hamburg, Germany,

[b]Bundeswehr Technical Center for Ships and Naval Weapons, Maritime Technology and Research (WTD 71)

The underwater radiated noise of maritime systems is known as acoustic signature and can be used for detection and identification of naval vessels. Structural and mechanical differences between different systems lead to characteristic signatures such that a clear identification is possible. This is in conflict with strategic interests in the military sector to hide the identity of a naval vessel.

To prevent a naval vessel from identification a process has to be developed that modifies the signature by the use of active methods without increasing the distance of revelation. In this study a system has to be integrated to a scaled model of a naval vessel that uses actuators assembled to the hull of the model to generate additional sound that superimposes the sound field according to the specifications.

13 Evaluation of range standards for underwater radiated noise measurements in beam aspect

Hans Hasenpflug[a], Layton Gilroy[b], Anton Homm[c], Stefan Schäl[c]

[a]Defence Materiel Organisation (DMO), The Hague, Netherlands

[b]Defence Research and Development Canada (DRDC), Atlantic Research Centre, Dartmouth, Nova Scotia, Canada

[c]Bundeswehr Technical Center for Ships and Naval Weapons, Maritime Technology and Research (WTD 71), Kiel, Germany

The underwater radiated noise levels of a small naval vessel were measured at the Heggernes deep water sound range. The data evaluation and analysis was performed in accordance with the NATO standard STANAG 1136 and the ISO 17208-1 standard. Both standards describe procedures for the determination of underwater radiated noise levels of ships in beam aspect on a deep water sound range. To assess and compare the results of both standards, the hydrophone configuration at the Heggernes range was utilized at various depth settings. Measurements were made of the ship in two different ship conditions (machinery states) and a variety of sailing speeds. Some of these measurements were repeated a large number of times. The resulting 3rd octave based spectra are used to compare the two procedures.