

CASE STUDY

Norwegian Defence Research Establishment Norway Noise Mapping of Military Vehicles

Europe
Automotive
PULSE, Transducers

The Norwegian military has launched a noise measurement of military equipment project with the objective of ensuring that soldiers get the best and most realistic training possible while adhering to the country's environmental legislation that includes staying within the noise levels allowed from military exercise areas.

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Fig. 1 The Leopard 2 battle tank in the exercise area



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Noise Mapping of Military Vehicles to Maximise the Use of a Battle Exercise Area

Driving a 60 ton Leopard 2 battle tank in an exercise area and knowing its exact location and the amount of noise it generates is challenging.

The Norwegian Defence Research Establishment (FFI) is the prime institution for defence-related research in Norway. It is also the chief advisor on defence-related science and technology to the Ministry of Defence and the Norwegian armed forces' military organisation. The area around FFI is home to a variety of research institutes, technology centres and some of Norway's Defence Logistic organisations. Altogether they employ some 3000 people.

At Rena, approximately 200 km north of Norway's capital, Oslo, the Norwegian military has created a huge exercise area for its elite division, the Telemark Battalion of professional soldiers who operate in national missions as well as in international operations. The Rena military camp is divided into three areas – the accommodation area, the shooting ranges, and the exercise area where Leopard 2 battle tanks and their crews are stretched to their maximum capabilities.

Brüel & Kjær microphones Type 4189 record the tank's sound pressure

"To ensure that we can use our exercise areas to their maximum and still keep a superior and long-lasting relationship with our civilian neighbours, we launched the noise measurement of military equipment project a couple of years ago," explains Morten Huseby, Senior Scientist at FFI.

"We can look at this from many perspectives but our objective is to ensure that our soldiers are getting the best and most realistic training possible while, at the same time, the Norwegian military adheres to the country's environmental legislations that include staying within the noise levels allowed from military exercise areas."

FFI and Brüel & Kjær have known each other for a long time and over the years Brüel & Kjær's microphones, accelerometers and amplifiers have been used in programs for sound and vibration measurement on both vehicles and other types of military equipment.



Noise Mapping of Military Equipment



"We had a clear idea of what we wanted and our specifications in relation to our existing simulation programs were identified. But to what extent any of the potential suppliers could live up to these was a different question," says Morten.

"Already early in the process it was obvious that we weren't wasting our time with Brüel & Kjær's engineers. They quickly understood the requirements of the project and it was clear that Brüel & Kjær Automotive could supply us with a noise measurement system according to our wishes."

Morten Huseby, Senior Scientist at FFI with the in-vehicle box containing CAN Bus and the GPS speed sensor (V-box)

Brüel & Kjær Application Specialist Bert van Amerongen describes the setup, "The system consists of three microphones placed at different locations at the side of the testing area where the signals were connected to PULSE data acquisition hardware. The second acquisition unit was placed in the Leopard tank to measure throttle position and GPS location. The two acquisition frames were connected via wireless LAN. The setup, using Brüel & Kjær PULSE software, measures real-time in 1/3-octaves, giving the operator a direct indication of the relevance of the measurement data, while at the same time storing the raw time data. The high-resolution GPS is achieved by using a GPS base station at a fixed position on the track. This unit sends correction data to the GPS unit on the battle tank and displays the measurement results with a resolution of just 2 cm for the geometric map".



Free Testing in the Exercise Area

To obtain the most realistic data, the idea was that the Leopard tank would drive freely in the area using its 47-litre, 1200 horse power engine just as in any typical military exercise. The Leopard tank would pass the microphones in all directions of the test area and under different driving conditions while making measurements. A GPS unit similar to the one keeping track on the tank was used to define the exact location of all measurement sensors such as the microphones and seismic transducers measuring vibration on the ground.

The data from the exercise area was exported as PULSE ASCII files to be processed in MATLAB[®] where the noise levels captured from each sensor were corrected for the distance to the Leopard tank and the noise maps created.



To Meet Future Challenges

“I am sure that, in the near future, we will see more legislation relating to the sound and vibration of military equipment and we will have to adhere to it. So this noise mapping initiative is just one of the projects that will place the Norwegian military at the forefront of this challenge,” says Morten.

“During this project we have had a strong working relationship with Brüel & Kjær. And for this specific project, I don’t hesitate when I say that the Norwegian military have gained maximum use of its exercise ground by monitoring noise and vibration levels with the measurement system from Brüel & Kjær,” concludes Morten.

Equipment Used

- PULSE In-vehicle system
- PULSE Groundstation
- Weather Station
- Three microphones
- CAN logger
- Racelogic GPS system
- KMT RPM

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