**Data Descriptor**

# AC Motor Voltage and Audible Noise Dataset

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## Abstract

The dataset titled AC motor voltage and audible noise waveforms in ship's electrical drive systems with frequency converters contains the voltage and sound measurement results recorded in a marine frequency controlled AC drive system. The dataset is part of research focussing on the impact of the ship's electrical drive systems with frequency converters on vibrations and the level of audible noise on ships. The dataset allows the correlation between electric disturbances and vibration, as well as audible noise in marine frequency controlled AC drive systems to be investigated.

**Keywords:** ship's electrical drive system; frequency converter; sinusoidal LC filter; AC motor voltage; audible noise; electric disturbances

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### Specification table (data records)

| | |
|---|---|
| Subject area | Metrology, Power Electronics, Acoustical engineering |
| More specific subject area | Electric disturbances measurements, audible noise measurements |
| Type of data | Text and audio files |

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|---|---|
| How the data was acquired | The data acquisition was carried out at the laboratory of the Department of Ship Automatic Control at Gdynia Maritime University using a model of a marine drive system with a frequency converter. The AC motor voltage waveform was preconditioned by an LV 25-P voltage isolating sensor. A ½ inch condenser microphone and sound level meter (Sonopan IM 10) were used to measure the acoustic noise. Both types of analogue waveforms were processed by the digital measurement system equipped with SCXI-13-10 Terminal Blocks, SCXI-1141 Antialiasing Filters and a PCI-MIO-16XE-50 DAQ Board. The digital data was saved on the PC hard disc |
| Data format | Text files are in .txt format, audio files are in .wav format |
| Experimental factors | The data contained in the dataset were not processed |
| Experimental features | A correlation between the harmonics content in the motor voltage waveforms and the acoustic noise of the motor was found |
| Data source location | MOST Wiedzy Open Research Catalog, Gdańsk University of Technology, Gdańsk, Poland |
| Data accessibility | The dataset is accessible and is publicly and freely available for any research or educational purposes |

## Background

In recent years, it is possible to observe a large number of frequency converters being applied to different drive systems with induction motors on ships, like in cranes, mooring winches, pumps, fans and in ship main drives (propellers). The power of the small fan motor can be less than 1 kW, but in the case of a ship's main engine, can reach even 6 MW. The efficiency of the frequency controlled AC drive system is very high, the motor speed control is very precise, overhaul is easy and not very frequent, and the frequency converters are not so expensive now. However, frequency converters have some disadvantages, because they generate electromagnetic disturbances in the wide frequency range. This happens due to the rectifier diodes and inverter transistors' commutation, which can be switched with the frequency from 2 kHz to 20 kHz. These disturbances, that are conducted to the system supply net and to the supply line of a motor, increase the vibrations of the whole drive system. Vibration components laying in the acoustic frequency range cause a significant increase of audible noise emitted by the drive system (Palczynska, Spiralski and Wyszkowski, 2005, pp. 73–76).

The dataset, AC motor voltage and audible noise waveforms in ship's electrical drive systems with frequency converters, has been designed to investigate the effect of electric disturbances on audible noise in frequency controlled AC drive systems. The conclusion of the study was to indicate that applying a filter connected at the output of the frequency converter not only reduces the level of electrical disturbances in the AC motor voltage

but also significantly decreases the level of an acoustic noise of the motor. The dataset contains the digital form of AC motor voltage (Fig. 31.1 – measuring point 9) and audible noise waveforms (Fig. 31.1 – measuring points 7 and 8). The dataset also includes measurement results for the repeated procedure with the output LC passive filter (Fig.31.1 – item no 3).

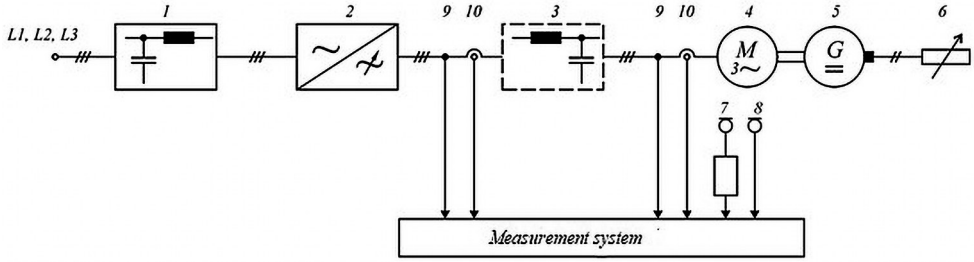


**Fig. 31.1.** Block diagram of the laboratory drive system. 1 – RFI filter, 2 – frequency converter, 3 – optimal sinusoidal output filter, 4 – induction motor, 5 – DC generator, 6 – adjustable resistor, 7 – Sonopan IM 10 sound level meter, 8 – microphone, 9 – LV 25-P voltage transducer, 10 – LA 55-P/SPI current transducer. (Wyszkowski, Spiralski and Winter, 2003)

## Methods

The experiments based on a model of the marine drive system with a frequency converter were performed at the laboratory of the Department of Ship Automatic Control at Gdynia Maritime University. The measurements were carried out for two cases, first, the squirrel cage asynchronous motor was connected directly to the output of the frequency converter, then to confirm the thesis of the correlation between harmonics contents in motor voltage waveforms and acoustic noise of the motor, the sinusoidal LC passive filter was connected at the output of the frequency converter. During tests, the motor was nominally loaded with the use of the DC generator connected to an adjustable resistor. The sound level meter was pointed directly to the source, positioned at a distance of 1m from the motor lifting eye, in the motor axis of symmetry, from the drive end, 1 m above the floor.

The data acquisition of the audible noise level (A-weighed) and voltage waveforms were carried out with the digital measurement system. The AC motor voltage and audible noise waveforms were recorded in digital form for a few different output voltage frequencies fout (20 Hz, 23 Hz, 25Hz, 40 Hz, 46 Hz, 50 Hz) and a few different inverter's transistors switching frequencies fsw (3 kHz, 6 kHz, 12 kHz). Then the measurement procedure was repeated with the output LC passive filter, for all output voltage frequencies fout and two inverter's transistors switching frequencies fsw (6 kHz, 12 kHz). The sampling frequency of the PCI-MIO-16XE-50 DAQ Board was equal to 20,000 Hz. The values of the voltage samples in volts are smaller than the motor supply line voltage due to the attenuation brought by the voltage isolating transducer. The measured sound level has been A-weighed during experiments.

## Data quality and availability

The standard uncertainties of voltage and acoustic measurement results were estimated using the B-type method. The relative uncertainty of the acoustic power measurements generated by an AC motor supplied from the frequency converter is less than 2.7% and depends, but not too much, on the inverter output frequency. However, when an output sinusoidal filter is used, the acoustic power generated by the AC motor decreases slightly, and is assessed with a relative measurement uncertainty of less than 2.6%. The main sources of uncertainty in sound level measurements are the sound meter errors related to the microphone directivity characteristics and the distance of the measuring points from the source. The relative uncertainty of the voltage measurements in both cases does not exceed 1.5%.

**Dataset DOI:**
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## References

Palczynska, B., Spiralski, L. and Wyszkowski, J. (2005) 'The influence of frequency controlled AC drives on vibration and audible noise level on ships', in: *Proceedings 10th IMEKO TC10 International Conference on Technical Diagnostics*, Hungarian Academy of Sciences, pp. 73–76.

Wyszkowski, J., Spiralski, L. and Winter, R. (2003) 'Digital Measurement system of electromagnetic disturbances and audible noise of marine frequency controlled AC drives', in: Book of summaries: *XVII IMEKO World Congress: Metrology in the 3rd millennium*: 22–27th June, 2003 Dubrovnik, Croatia, Croatian Metrology Society, pp. 2108–2111.