

ANIMAL

Modeling potential masking of echolocating sperm whales exposed to continuous 1–2 kHz naval sonar

COMPUTATIONAL

Sensitivity analysis of pinna morphology on head-related transfer functions simulated via a parametric pinna model

ENGINEERING

Development of an ultrasound level meter for use in occupational safety and health

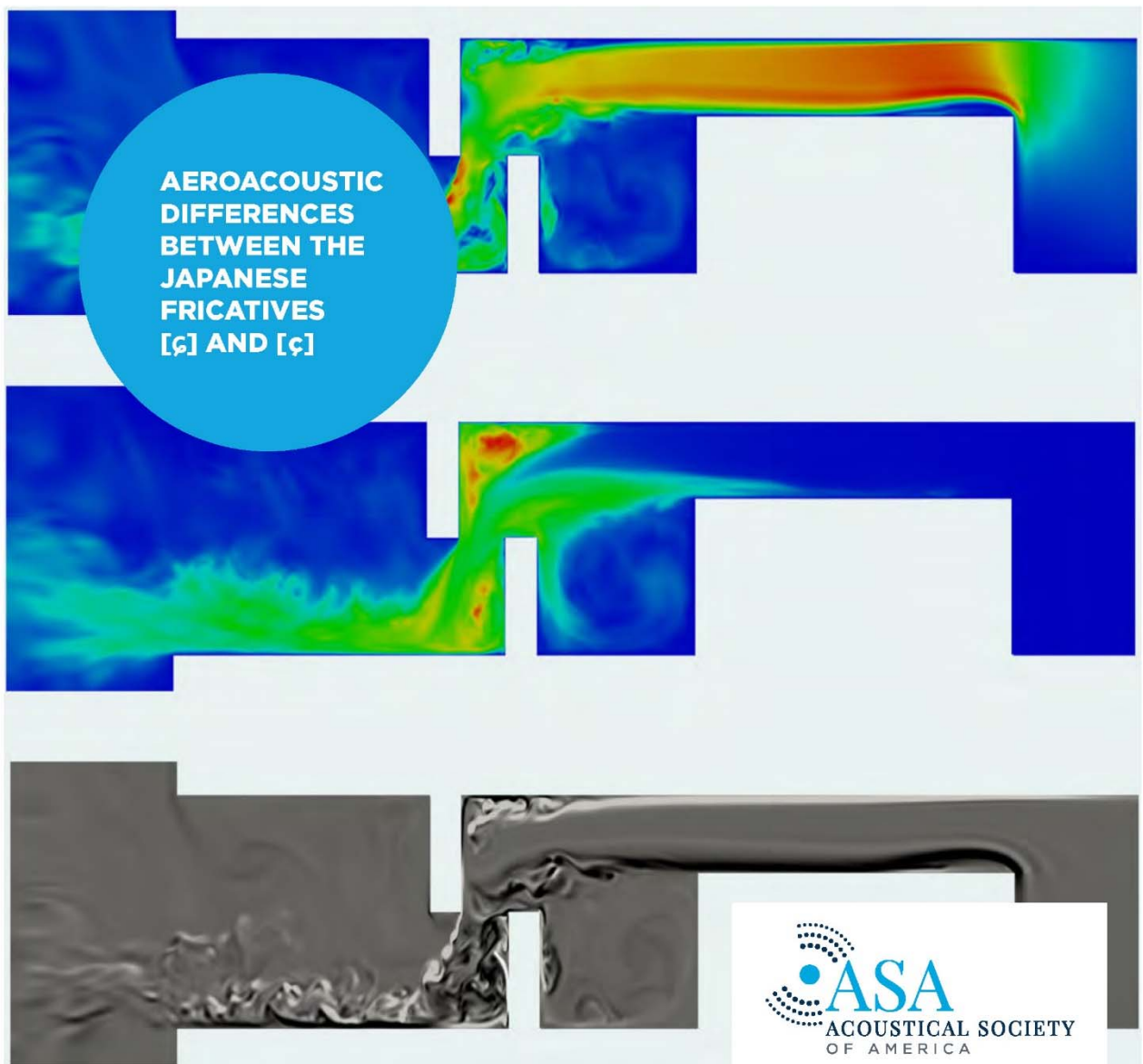
MUSICAL

Absolute pitch is disrupted by a memory illusion

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Selective monitoring of noise emitted by vehicles involved in road traffic

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The aim of the project carried out by a Gdansk University of Technology in cooperation with an electronics company is to conduct industrial research, development, and pre-implementation works on a new product, namely an intelligent lighting platform. This kind of street lamp system called infoLIGHT using a new generation of LEDs will become a smart city access point to various city services (Fig. 1).



Figure 1 Intelligent lighting platform – infoLIGHT project website

The research focuses on the electronics built in the street lamp using multiple sensors (Fig. 2),

including an acoustic intensity probe that measures the sound intensity in three orthogonal directions, making it possible to calculate the azimuth and elevation angles, describing the sound source position.



Road lamp design

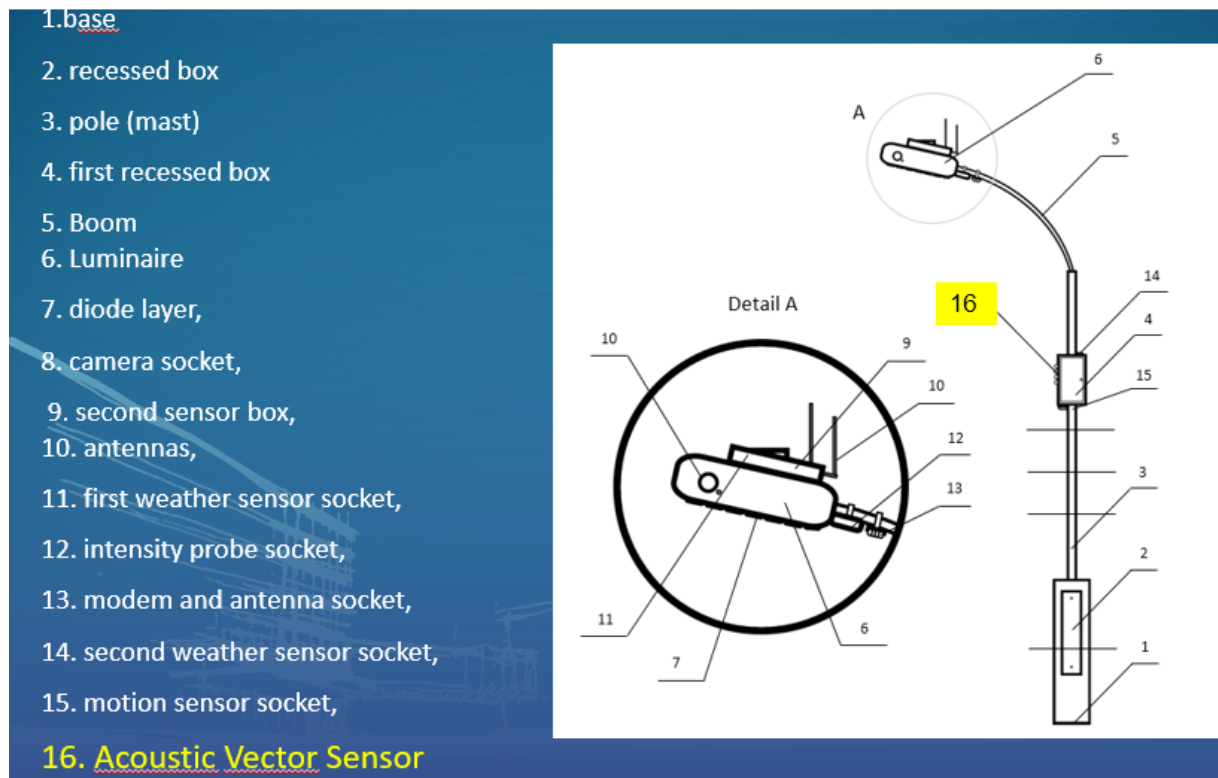


Figure 2 – Road lamp design

The acoustic sensor is made in the form of a cube with a side of 10 mm, on the inner surfaces of which the digital MEMS microphones are mounted (Fig. 3). The acoustic probes were mounted on the lamp posts that illuminate the roadways depending on the volume of traffic.

The Vector Acoustic Sensor module consists of 3 main elements:
(1) acoustic sensor, the housing containing the sensor power supply and systems for data transmission, and (3) wind protection housing

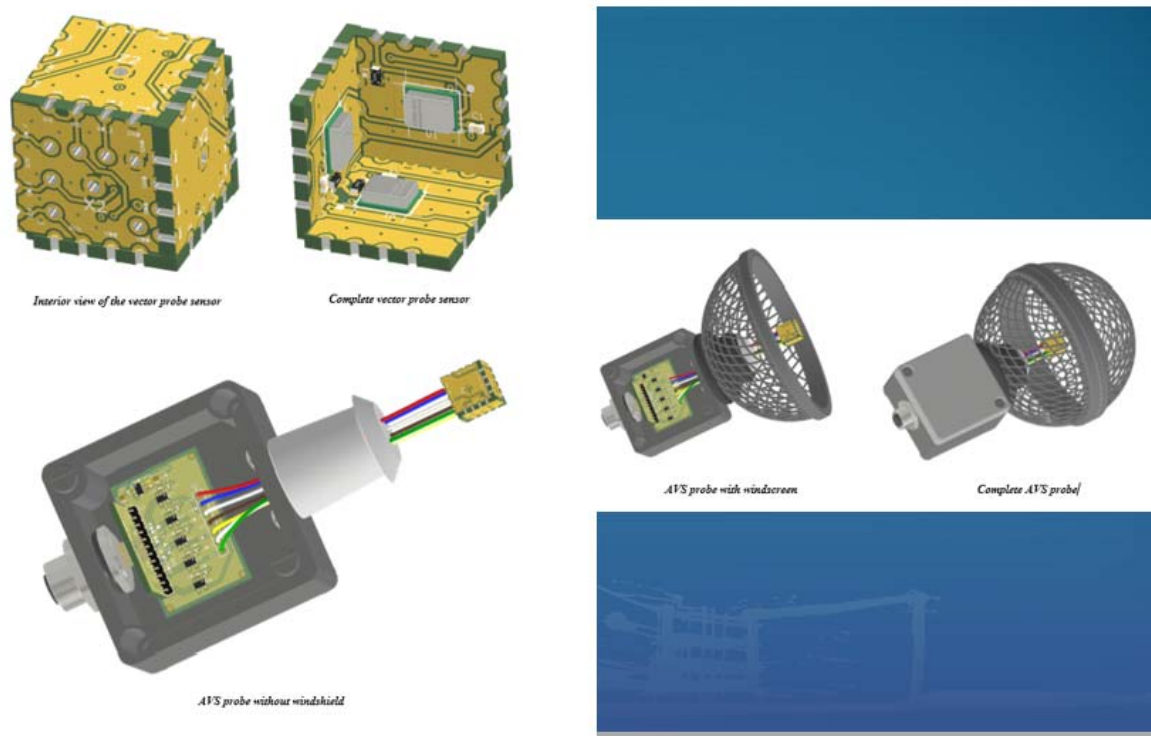


Figure 3 Acoustical vector sensor - construction

The algorithm works in two stages. The first stage is the analysis of sound intensity signals to detect acoustic events. The second stage analyses acquired signals based on the normalized source position; its task is to determine whether the acoustic event represents what kind of a vehicle passing the sensor and detecting its movement direction. A neural network was applied for selective analysis of traffic noise (Fig. 4). The neural network depicted in Figure 4 is the so-called 1D (one-dimensional) convolution neural network. It was trained to count vehicles passing by through the analysis of noise emitted by them.

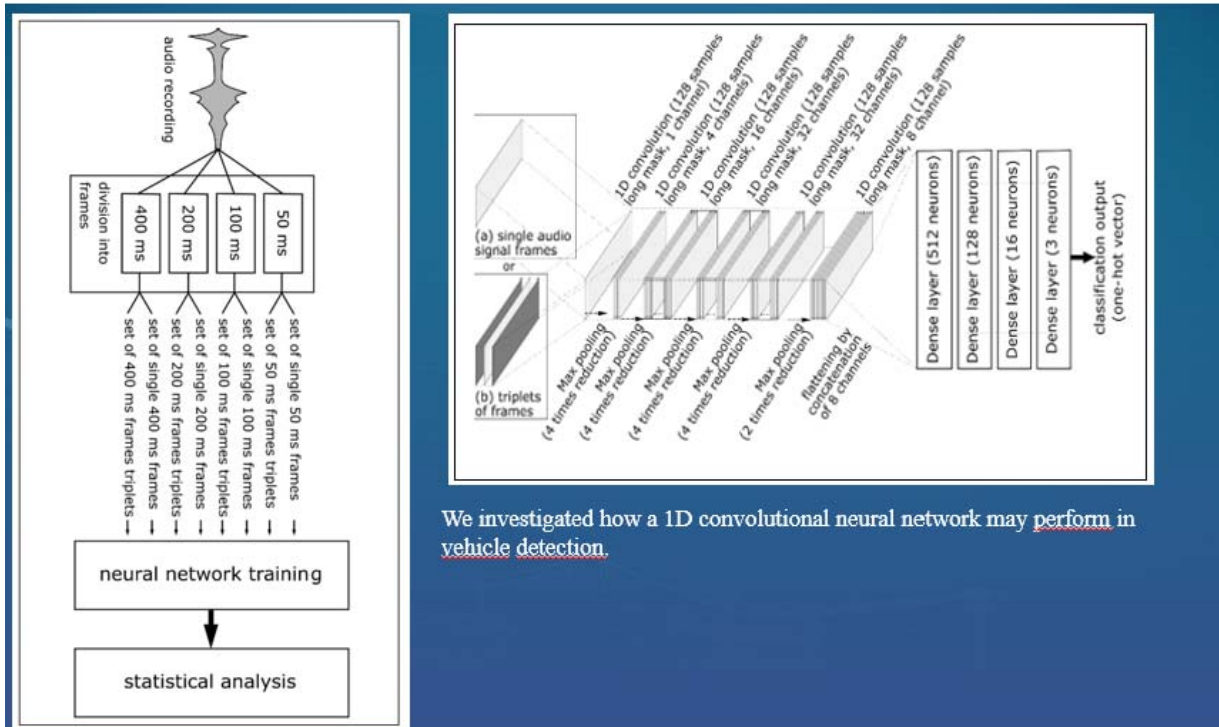


Figure 4 Neural network applied for selective analysis of traffic noise

The paper explains how accurately traffic can be monitored through directional noise analysis emitted by vehicles and shows the resulting application to smart cities (see Fig. 5). It provides an extension of a previous papers devoted to application of acoustic probe and other sensors in the Intelligent road signs [

Number of detected vehicles based on three methods: 1. Doppler Radar, 2. LiDAR, 3. acoustic method under development, and 4. manual counting data based on video stream

No. of minutes of examination	Doppler	LiDAR	Acoustic	Ground truth
5	121	124	125	152
10	216	221	286	271
15	319	332	385	392
20	432	442	482	546
25	523	543	576	667
30	614	642	680	794
35	720	756	809	913
40	839	874	932	1081
45	945	985	1063	1204

Figure 5 Comparative results of traffic analysis employing various approaches

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Protected industrial design (Polish Patent Office, Application No. Wp.28574)