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#### 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

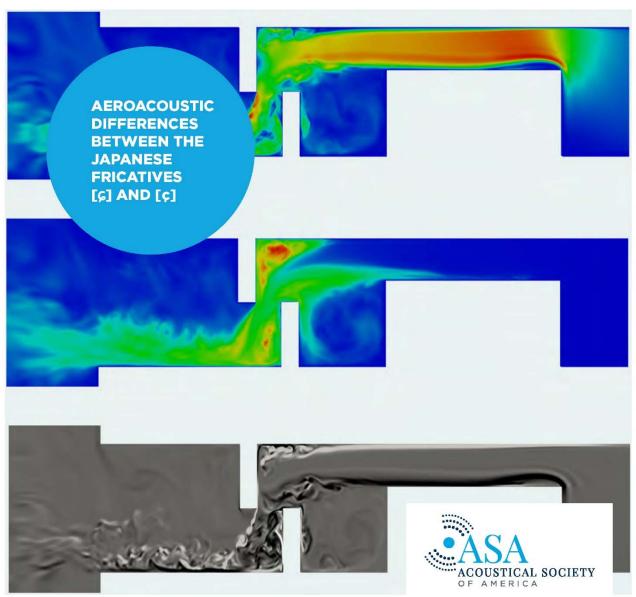
#### ENGINEERING

Development of an ultrasound level meter for use in occupational by a memory illusion safety and health

Absolute pitch is disrupted



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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).



## Intelligent lighting platform



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

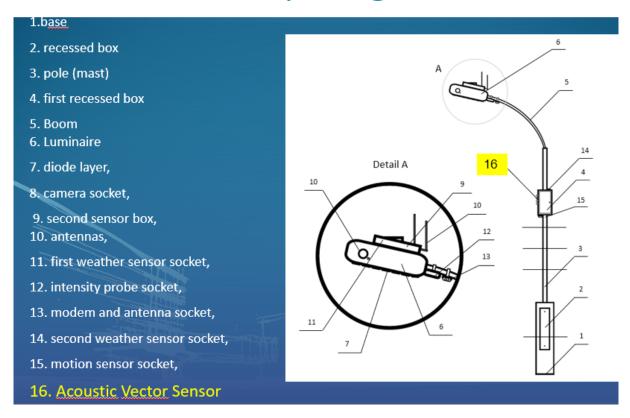


Figure 2 – Road lamp design

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

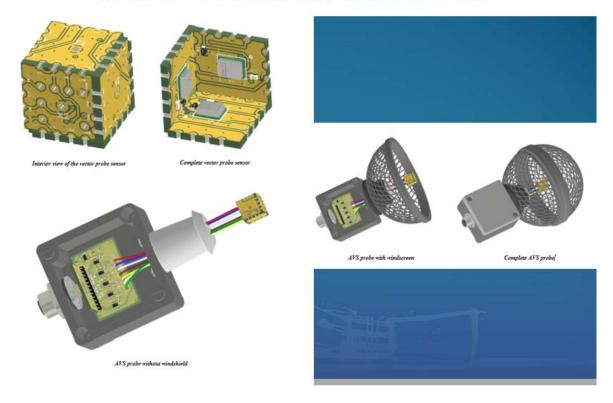


Figure 3 Acoustical vector sensor - construction

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.





## Neural network application

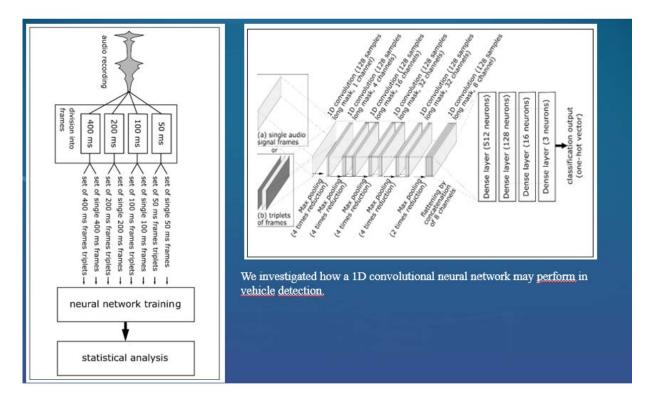


Figure 4 Neural network applied for selective analysis of traffic noise

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

Doppler	LiDAR	Acoustic	Ground truth
121	124	125	152
216	221	286	271
319	332	385	392
432	442	482	546
523	543	576	667
614	642	68o	794
720	756	809	913
839	874	932	1081
945	985	1063	1204
	121 216 319 432 523 614 720 839	121 124 216 221 319 332 432 442 523 543 614 642 720 756 839 874	121     124     125       216     221     286       319     332     385       432     442     482       523     543     576       614     642     680       720     756     809       839     874     932

Figure 5 Comparative results of traffic analysis employing various approaches

## Acknowledgements

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