PHYSICAL SENSORS FOR ENVIRONMENTAL SIGNALS

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A.y. 2024-2025

SENSING THE ENVIRONMENT

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Sources

- Temperature
- Pressure
- Distance and position
- Speed
- Vibrations
- Acoustic
- Radiations: particles & light
- Chemical pollutants

VIBRATIONS

- Seismic waves: earthquakes vs explosions

  References:

  https://www.annualreviews.org/doi/10.1146/annurev-earth-071822-100323,

  http://www.ijmmm.org/vol7/428-CM0010.pdf ,

  https://www.nature.com/articles/s41598-022-25098-1 <—

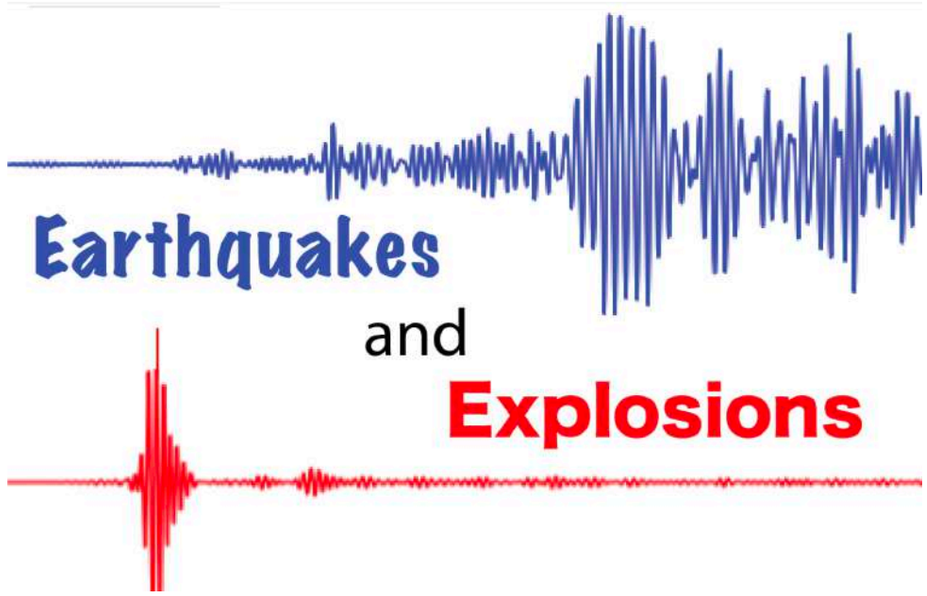
  Datasets: https://seisbench.readthedocs.io/en/latest/pages/benchmark_datasets.html

- Seismic waves: correlation with sea waves height and seismometric data

  References:

  https://www.frontiersin.org/articles/10.3389/fmars.2022.798167/full ,

  https://www.sciencedirect.com/science/article/pii/S1364815223001676 <—



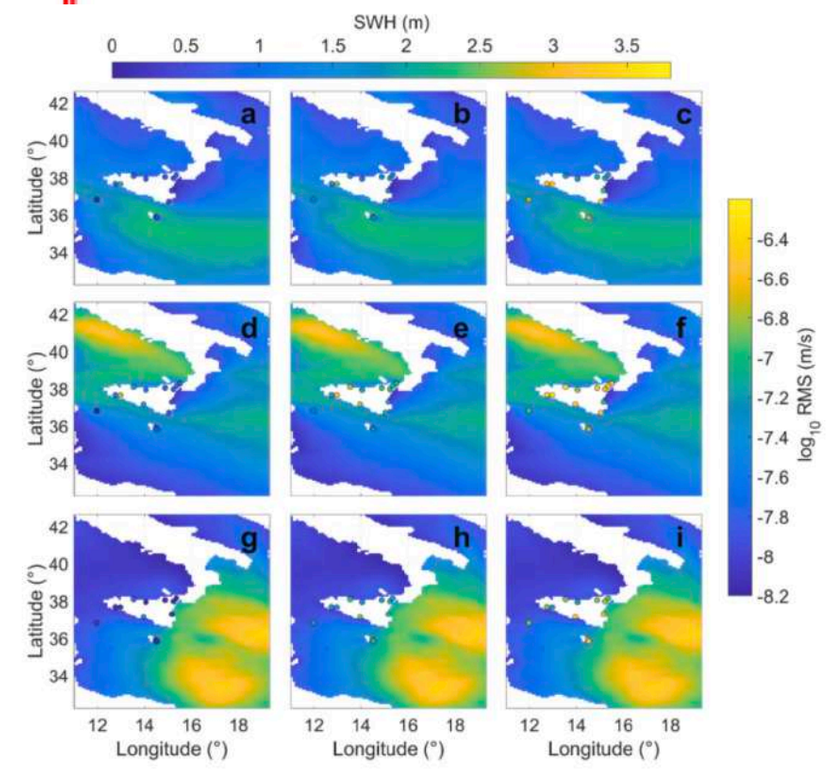
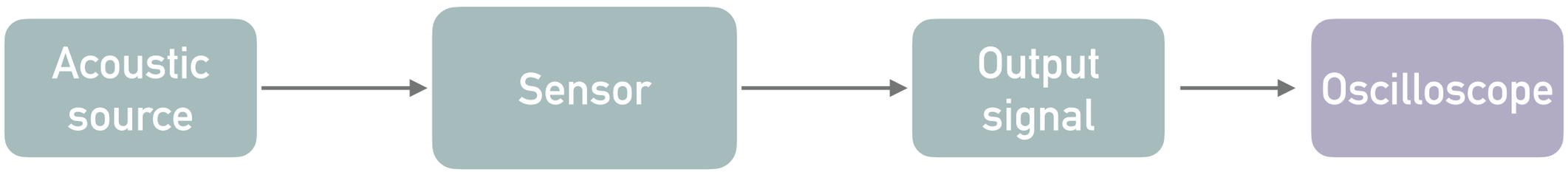


Fig. 8. **Spatial distribution of seismic and sea state data.** Maps of the spatial distribution of the daily average significant wave height (SWH) and of the daily average RMS amplitude values of the seismic signals (colored dots; only vertical component) recorded

ACOUSTICS

- Voice reconstruction with microphones



- Signal: natural acoustic source (environmental bkg, different voices)
- Sensor: microphone
- Read the signal output: oscilloscope

From Lab.2

NLP (Natural Language Processing - https://research.aimultiple.com/nlp/):

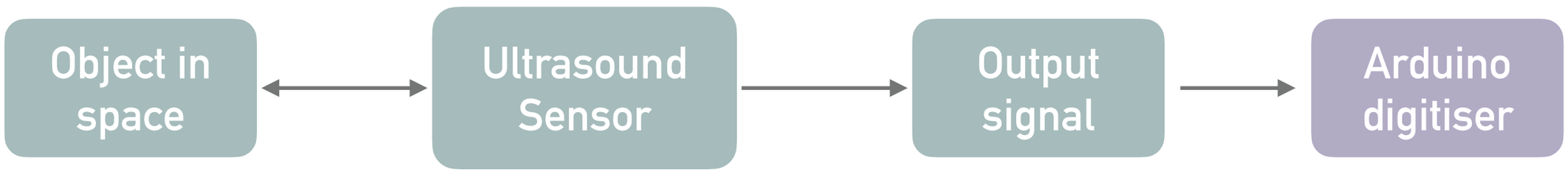
- Words identification/Speech recognition in an audio stream
  Reference NLP-ASR: https://research.aimultiple.com/speech-recognition/
- Voices identification/Voice recognition in an audio stream
  Reference NLP-vs-NLU: https://research.aimultiple.com/nlu-vs-nlp/

Denoising

- Deconvolving audio ambient noise from main voice (active noise cancelling)
  Example: https://paperswithcode.com/paper/speech-denoising-without-clean-training-data

POSITION AND DISTANCE

- Position and shape reconstruction with ultrasound sensors



- Source: static element in space
- Sensor: ultrasounds detector (x,y,z mapping) → ***From Lab.3***
- Read the sensor output: Arduino digitiser

References:

- *A Survey on 3D Ultrasound Reconstruction Techniques, DOI: 10.5772/intechopen.81628*

Dataset:

https://dataverse.harvard.edu/dataset.xhtml?persistentId=doi:10.7910/DVN/KVN7CY <—

https://www.kaggle.com/datasets/uciml/wall-following-robot

IONISING/NON-IONIZING RADIATION

- Radiocarbon dating

  Topics: Identification of mechanisms of carbon stabilisation and destabilisation over time

  References/Datasets: https://essd.copernicus.org/articles/12/61/2020/

- Solar cells

  Topics: ML for reconstructing solar cell output and/or for optimising power generation

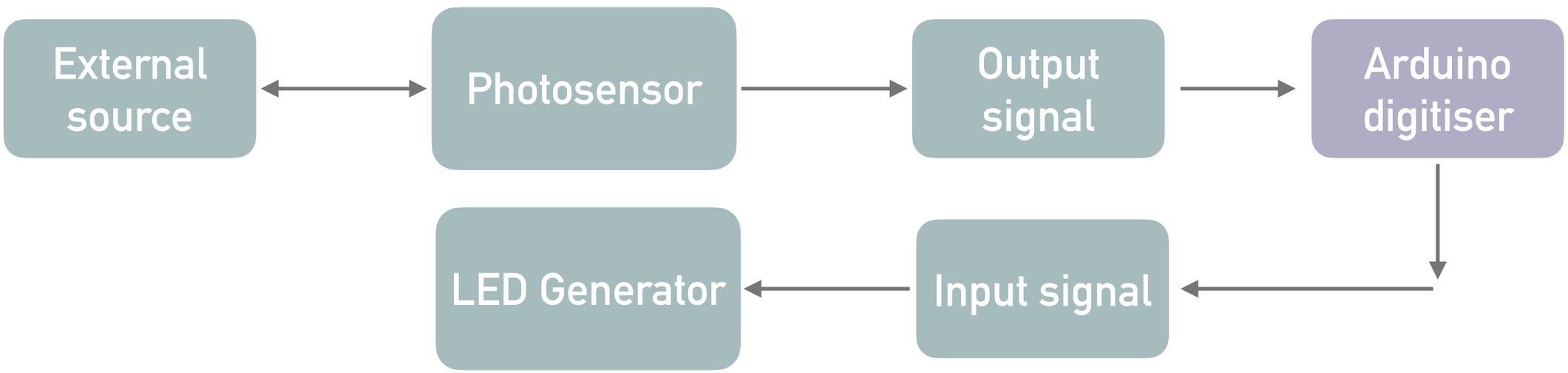
  References: https://link.springer.com/chapter/10.1007/978-981-99-0393-1_1

  Datasets: https://paperswithcode.com/dataset/solar-power,

  https://paperswithcode.com/dataset/skipp-d

NON-IONISING RADIATION

- Smart lighting



- External source: Ambient light
- Sensor: Phototransistor
- Light generator: LED
- Read the photosensor output and drive the LED: Arduino digitiser

From Lab.4

References:

- *Machine Learning Methods in Smart Lighting Toward Achieving User Comfort: A Survey, DOI: 10.1109/ACCESS.2022.3169765*
- *How AI Takes Smart Lighting to the Next Level, https://aijourn.com/how-ai-takes-smart-lighting-to-the-next-level/*

REFERENCES

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- https://research.aimultiple.com/
- https://www.kaggle.com/datasets
- https://paperswithcode.com/