Uses of UltraSonic Embedded Sensors

Project 101072599 — HORIZON-MSCA-2021-DN-01

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Sensor data quality evaluation for monitoring applications in civil structures

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Zensor
DC10

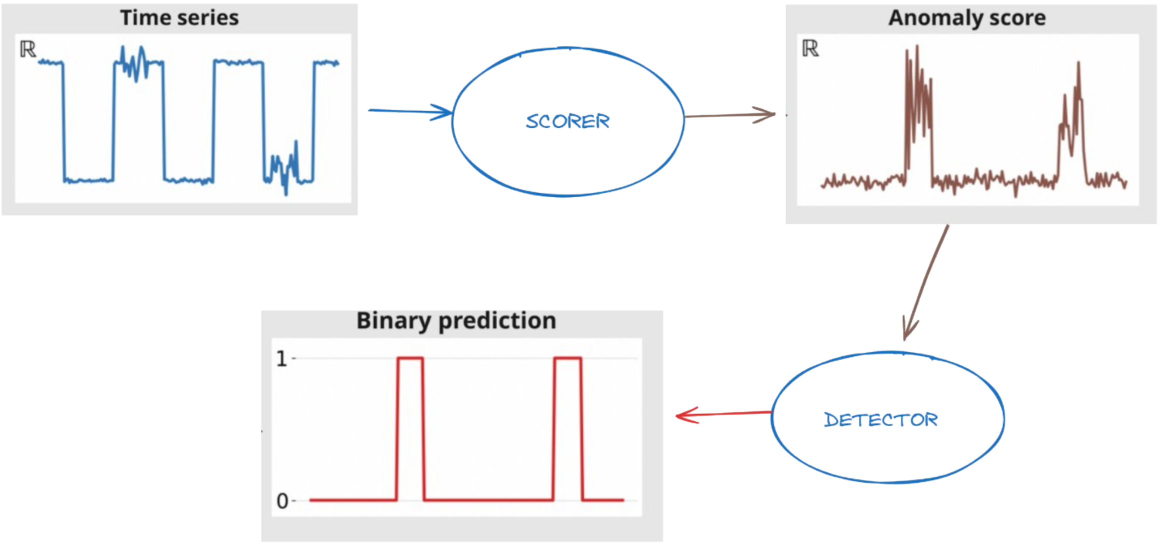
Framework design and development

Objective

Developing a framework aims to provide a pipeline for **sensor** data validation, facilitating uninterrupted further processing and analysis.

How?

- Using methods for detecting **data-anomalies** (outliers, faults, gaps, noise, …)
- Possibly **fusing** and correlating data from multiple sensors
- Utilize the domain knowledge of observed phenomena



Example of anomaly scoring by Julien Herzen et Al. licensed CC BY

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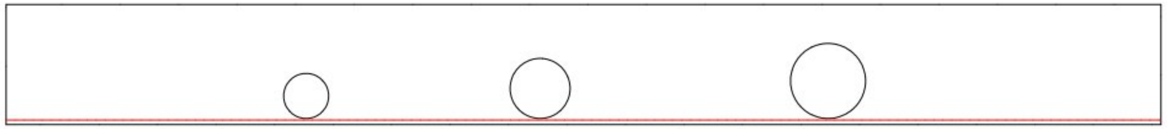
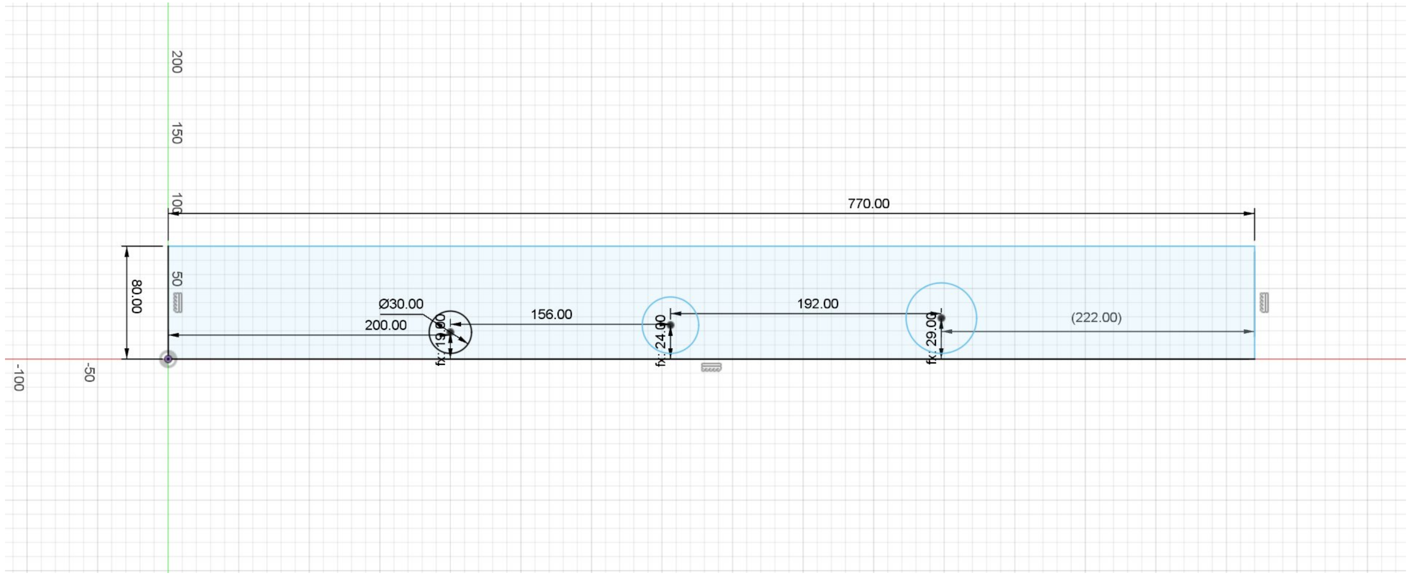
New skills in FEM e CAD, for experiment design

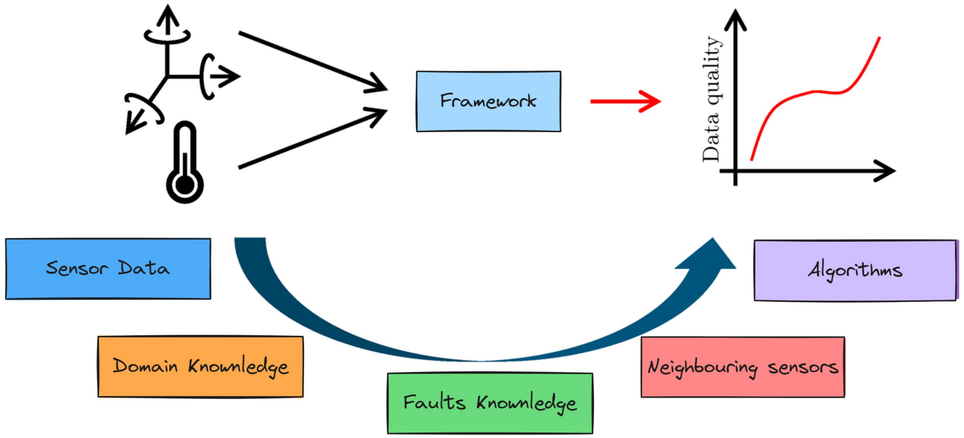


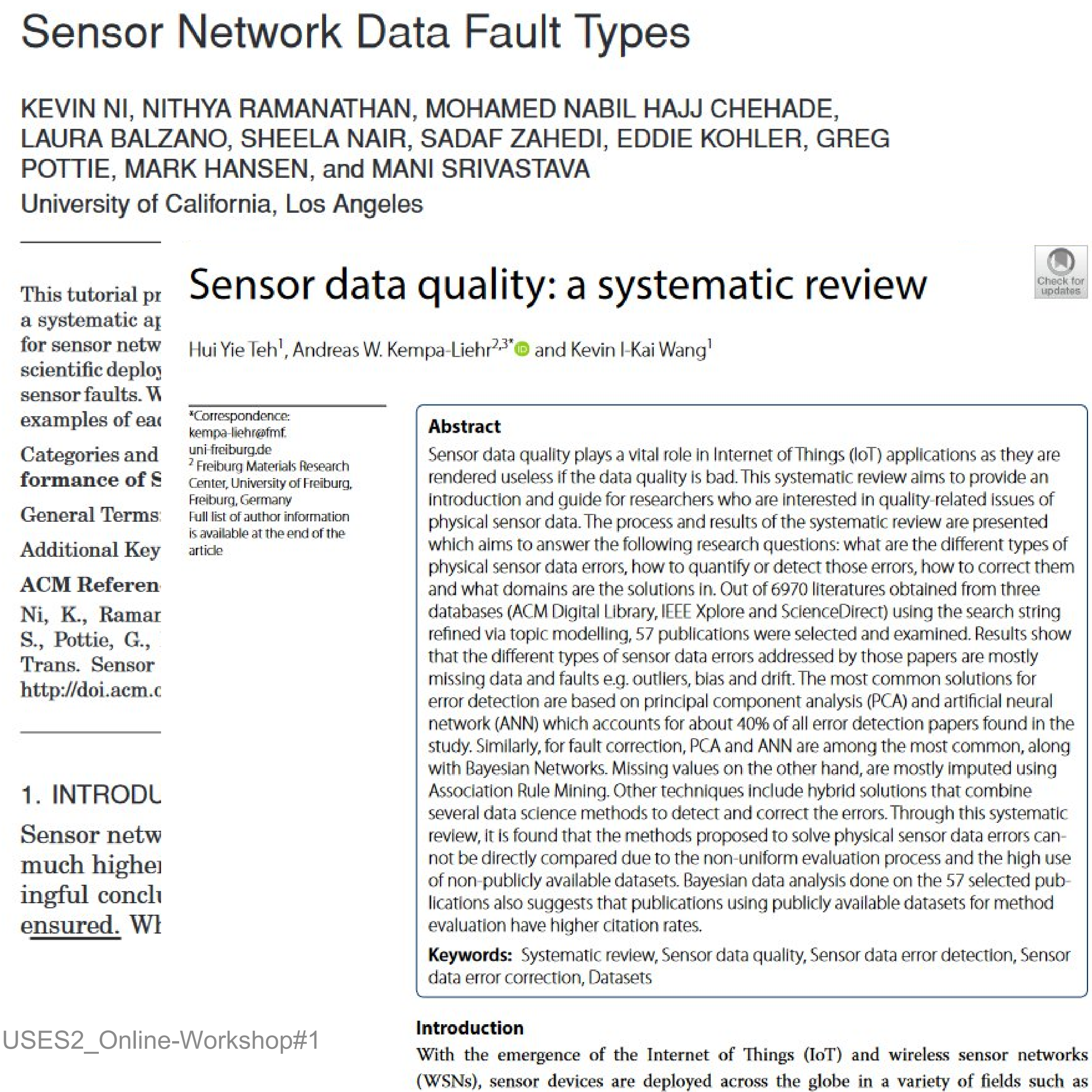
Fiber-line where the axial measurements are extracted

Water-jet cutting process, resulted from the CAD



Writing SOA Report





Sensor Network Data Fault Types

KEVIN NI, NITHYA RAMANATHAN, MOHAMED NABIL HAJJ CHEHADE, LAURA BALZANO, SHEELA NAIR, SADAF ZAHEDI, EDDIE KOHLER, GREG POTTIE, MARK HANSEN, and MANI SRIVASTAVA
University of California, Los Angeles

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Sensor data quality: a systematic review

Check for updates

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Abstract

Sensor data quality plays a vital role in Internet of Things (IoT) applications as they are rendered useless if the data quality is bad. This systematic review aims to provide an introduction and guide for researchers who are interested in quality-related issues of physical sensor data. The process and results of the systematic review are presented which aims to answer the following research questions: what are the different types of physical sensor data errors, how to quantify or detect those errors, how to correct them and what domains are the solutions in. Out of 6970 literatures obtained from three databases (ACM Digital Library, IEEE Xplore and ScienceDirect) using the search string refined via topic modelling, 57 publications were selected and examined. Results show that the different types of sensor data errors addressed by those papers are mostly missing data and faults e.g. outliers, bias and drift. The most common solutions for error detection are based on principal component analysis (PCA) and artificial neural network (ANN) which accounts for about 40% of all error detection papers found in the study. Similarly, for fault correction, PCA and ANN are among the most common, along with Bayesian Networks. Missing values on the other hand, are mostly imputed using Association Rule Mining. Other techniques include hybrid solutions that combine several data science methods to detect and correct the errors. Through this systematic review, it is found that the methods proposed to solve physical sensor data errors cannot be directly compared due to the non-uniform evaluation process and the high use of non-publicly available datasets. Bayesian data analysis done on the 57 selected publications also suggests that publications using publicly available datasets for method evaluation have higher citation rates.

Keywords: Systematic review, Sensor data quality, Sensor data error detection, Sensor data error correction, Datasets

Introduction

With the emergence of the Internet of Things (IoT) and wireless sensor networks (WSNs), sensor devices are deployed across the globe in a variety of fields such as

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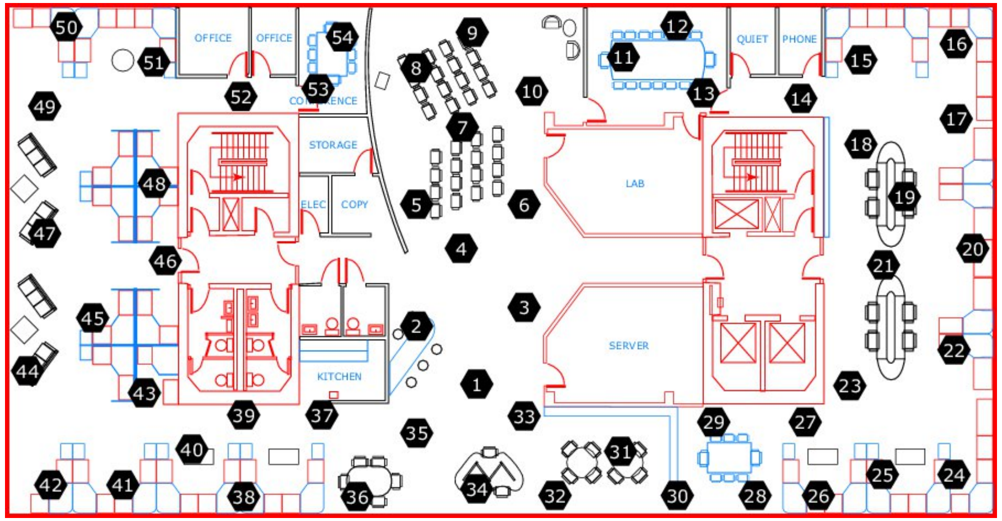
Understanding Environmental Monitoring needs



Discover Applied Sciences

Research

Prediction and classification of IoT sensor faults using hybrid deep learning model

Adisu Mulu Seba[1] · Ketema Adere Gemeda[1] · Perumalla Janaki Ramulu[2]

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Published online: 20 Janu

Abstract
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Benchmark Datasets for Fault Detection and Classification in Sensor Data

Bas de Bruijn[1], Tuan Anh Nguyen[1], Doina Bucur[1] and Kenji Tei[2]
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Keywords: Benchmark Dataset, Fault Tolerance, Data Quality, Sensor Data, Sensor Data Labelling.

Abstract: Data measured and collected from embedded sensors often contains faults, i.e., data points which are not an accurate representation of the physical phenomenon monitored by the sensor. These data faults may be caused by deployment conditions outside the operational bounds for the node, and short- or long-term hardware, software, or communication problems. On the other hand, the applications will expect accurate sensor data, and recent literature proposes algorithmic solutions for the fault detection and classification in sensor data. In order to evaluate the performance of such solutions, however, the field lacks a set of *benchmark sensor datasets*. A benchmark dataset ideally satisfies the following criteria: (a) it is based on real-world raw sensor data from various types of sensor deployments; (b) it contains (natural or artificially injected) faulty data points reflecting various problems in the deployment, including missing data points; and (c) all data points are annotated with the *ground truth*, i.e., whether or not the data point is accurate, and, if faulty, the type of fault. We prepare and publish three such benchmark datasets, together with the algorithmic methods used to create them: a dataset of 280 temperature and light subsets of data from 10 indoor *Intel Lab* sensors, a dataset of 140 subsets of outdoor temperature data from *SensorScope* sensors, and a dataset of 224 subsets of outdoor temperature data from 16 *Smart Santander* sensors. The three benchmark datasets total 5,783,504 data points.

Take advantage of Transfer Learning

Study paper

Understand methodology, see limitations,

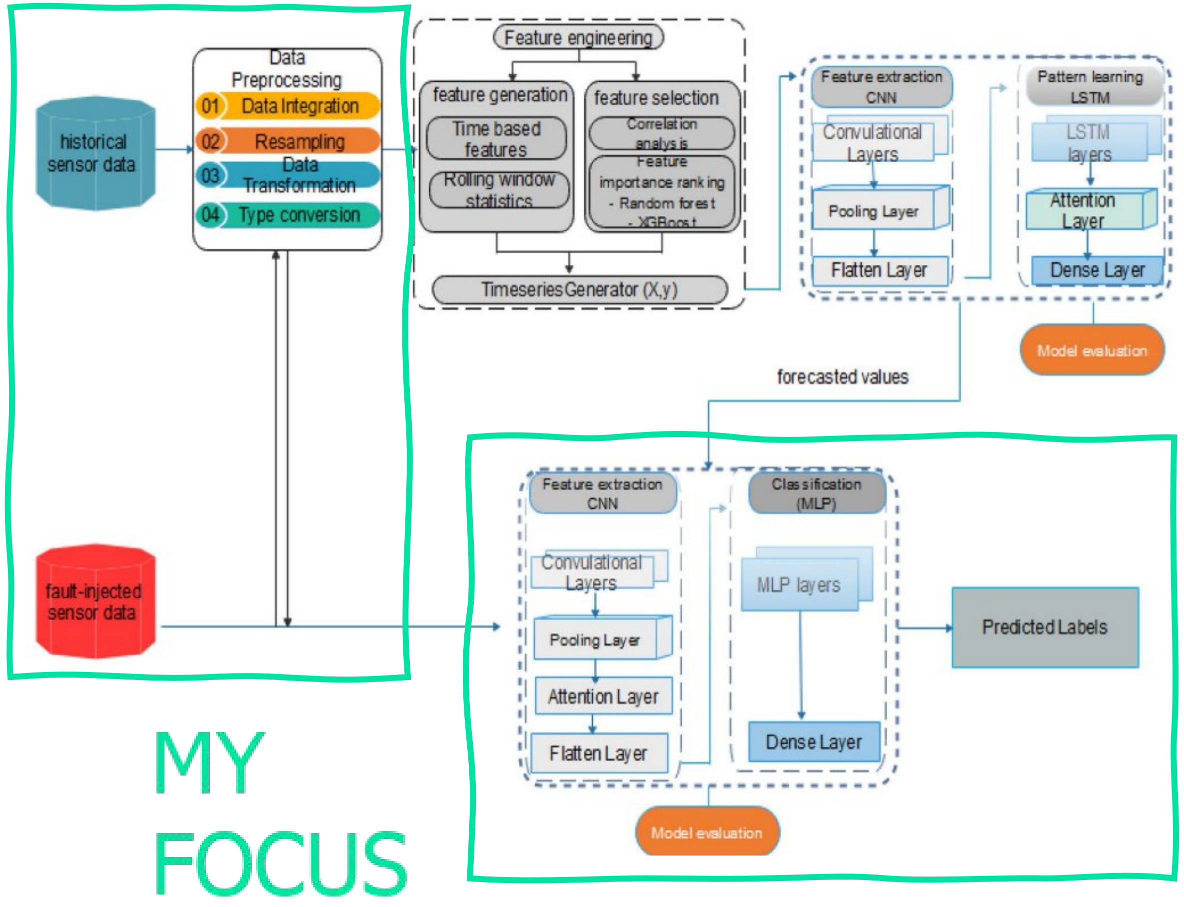
Analyze dataset

Often used as benchmark, relevant for my research

Write code

Reproduce result, familiarize with the API,

Share it with Zensor/USES2



Thank you for your attention

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