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# Project report Student-active learning methods for TFY4280 Signal Processing

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## Introduction

In 2023, JOA applied for funding at the NV faculty at NTNU to hire a teaching assistant in TFY4280 Signal Processing to develop student-active learning methods. HAHS was a teaching assistant in 2023 and due to his experience in this course as well as his strong background in numerics, he was hired. This document is a joint report based on our experience in the spring semester 2024.

Teaching the course for the first time in 2023, it was clear that the students have very different backgrounds: physics, biophysics, electrical and mechanical engineering as well as neuroscience. It would therefore be advantageous to develop projects that reflect this diverse background. HAHS was hired in the fall 2023 to develop two new projects. The first project described below was already developed in 2023

## Short description of projects

We briefly describe each project below. We will be happy to provide a full description upon request.

## **Gravitational waves**

The raw data for this project are the gravitational wave data provided by the Laser Interferometer Gravitational-Wave Observatory (LIGO). After filtering the data using different types of filters, the students obtain a signal which is reminiscent of the signal that was published by Abbott BP, et al. (LIGO Scientific Collaboration and Virgo Collaboration) (2016). "Observation of Gravitational Waves from a Binary Black Hole Merger". Physical Review Letters. 116 (6): 061102. This signal was the first direct evidence of gravitational waves, considered a huge scientific breakthrough.

## **Pitot probe**

This task was designed using a bachelor's thesis written in 2023 by HAHS. The students receive data collected in a small aerodynamic wind tunnel. The data were collected using a EvoScann P8-A pressure sensor. For the task the students have to design filters to remove noise from the data. After filtering their task is to find the wind velocity in the wind tunnel at the time of the data sampling.

## **Electrocardiogram of a human heart**

In this project, the students get the data for an electrocardiogram (ECG) for a healthy individual and for a patient diagnosed with sleep apnea. The students are asked to design some filters to remove the noise from the data. After filtering, the difference between the two ECGs should be clear and the student is able to decide which patient is healthy (the healthy heart has regular heartbeats or spikes in the filtered signal).

## **Conclusions**

The different assignments that the students can choose from reflects the diverse group of students taking the course. Based on the feedback from the reference group the changes have been well received. Moreover, the workload has to be reasonable since many other courses have mandatory assignments. The fact that the mandatory activities are more demanding than earlier years (each student has a blackboard presentation as well two larger assignments), has led to a significant decrease in the number of students. The number has dropped from more than 50 in previous years to approximately 15. Students have informed us that the course had a reputation of being very easy compared to most other courses offered by the Department of Physics. After the changes, this is certainly no longer the case. JOA will continue to use the format and the assignments in 2025. It is also easy to modify the assignments and successors can freely use them.

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