Fontys ASIA TN-projects nominated for the KIVI-award

Online session KIVI and Fontys 7-7-2021

Program:

Het programma van de sessie is:

Welkom van WJ en korte introductie van KIVI	10:00-10:10
Aquaponics (project 1) met projectleider B. Braakhekke	10:10-10:25
Warmtebatterij met projectleider T. van Os	10:25-10:40
OpZuid met projectleider T. Reuvers	10:40-10:55
Heatsink tool met projectleider R. Bens	10:55-11:10
Patroon herkenning met projectleider B. Klinkenberg	11:10-11:25
KIVI overleg en bekendmaking winnaar	11:25-11:40

Projects

project no 1 Aquaponics: **Fontys code 012**
project no 2 Warmte batterij: **Fontys code 013**
project no 3 OPzuid: **Fontys code 011**
project no 4 Heatsink tool: **Fontys code M11**
project no 5 patroonherkenning : **Fontys code 014**

Project summaries

Project no 1 Aquaponics

Minor Technische Natuurkunde
Title **ASIA project Aquaponics**
Subtitle Determining the effect of water in lettuce on the capacitance of a capacitor.

Introduction
Knowing the amount of water in a crop while it is growing is quite useful for agriculture. Due to the properties of water, it is detectable when placed in a capacitor. Our goal is determining if it is possible to measure water in lettuce this way and constructing a prototype.

Project description
A previous Fontys project hinted at the possibility of measuring water with a capacitor, and perhaps even when stored in a leaf. This is also supported by the known theory on the dipole moment of water.
Using a large capacitor, it was found that lettuce affects the measured capacitance when placed between the plates.

The steps following this observation were understanding and calibrating the relation between measurements and water. This was achieved by placing a plexiglass tray between the plates and filling this tray with known amounts of water. This way the increase in capacity was measured against the amount of water.

As expected, this resulted in a linear relation. Our main objective after this, was testing if the water in lettuce behaved the same way. To properly confirm this, leaves of iceberg lettuce were placed in the same plexiglass tray as the water. After measuring the leaf, it was placed in a drying oven at 40 °C for an hour, and measured again. This process is repeated multiple times, for leaves with a different mass.

Contrary to expectations based on the water measurements, the leaves showed quite peculiar behaviour. The heavier leaves resemble a linear correlation with a greater slope while the curve of the lighter leaves flattens when dried more. These differences are suspected to be caused by the different shapes the leaves take after being dried and other substances present.

To eliminate this factor, lettuce was blended and again dried and measured. This resulted in a behaviour much more similar to water, but still deviating slightly due to vegetable matter.

From these tests it is concluded that the amount of water can be measured using this relation. This is when the final phase of the project is reached, constructing a useable prototype to detect the amount of water in lettuce using a non-invasive method.

The core of the prototype are small laser cut steel discs, that are used as capacitors. These are covered by a cork layer to prevent them touching the lettuce. The prototype is then clamped on a leaf to measure it. This prototype is in its infancy and can be further improved in future projects.

Fontys tutor Victor Snels
Project team I. van Bakel, B. Braakhekke, T van Molken, S Rosloot, B van Strien

Company: Fontys
Company contact Urs Wyder (Fontys)

Project no 2 Modelling the K2CO3 Heat Battery

Minor Currently, no Minor
Title **Modelling the Gibbs Energy of a K2CO3 Heat Battery**
Subtitle The first steps in finding the theoretical maximum efficiency of a heat battery.

Introduction
We have been asked by iHeat@Home, TNO and the TU/e to develop a model that can determine the theoretical maximum efficiency of a salt-hydrate heat-battery. This maximum efficiency can be used to compare the potential of heat-battery technology to other energy storage solutions.

Project description
At the start of the project we were handed some general background information about thermodynamics by a previous project group. From this point, we had to find out what information is relevant and applicable to a heat-battery. The biggest challenge was to define a clear roadmap to finding the theoretical maximum efficiency. Furthermore, there was no detailed description of the actual workings of the system, so we had to figure out how the heat-battery operated. Lastly, we had to find new theoretical models and apply them to our specific problem.

At first we had no clue where to start and what the end result of this project would be. We set ourselves an ambitious goal of completely figuring out how to calculate the maximum efficiency, but as we soon came to learn, this might have been too ambitious. Therefore, we have tried to make the most progress in finding this theoretical maximum efficiency as we could by trying to model the Gibbs-free energy and enthalpy of mixing of this system. If these parameters can be determined, finding the true maximum efficiency is within close reach.

By the end of this project, we have set up a clear roadmap for a following project group. Furthermore, we have made a more detailed description of the workings of the heat-battery. We also have been able to create a model with which the Gibbs free energy can be determined as function of temperature and mole fraction and a potential method to also model this as function of pressure. In conclusion, we have made the first steps in determining the theoretical maximum efficiency of a heat-battery.

Fontys tutors Saskia Blom
Urs Wyder
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Project team A Neefs, T van Os, D Juma, Y landman

Company: Fontys

Project no 3 Opzuid Polarization selective antennas

Minor N/A
Title **Polarization Selective Antennas**
Subtitle Development of an optical stress temperature sensor

Introduction
OPzuid is developing an optical detection method to predict gas pipe leakages to prolong the lifetime of several pipeline components. Due to the risks of hydrogen gas and natural gasses, electronics are not safe to use near the gas pipes. Instead, possibilities for optical detection systems are being explored.
Project description
The focus for the detection of leakages at the flanges is the detection of stress. This can be done using a Fiber Bragg Grating (FBG) integrated in the gasket. FBGs are highly sensitive to small deformations caused by stress due to the effects of total internal reflection. When the pressure in a pipe rises, the gasket expands slightly, distorting the fiber, which can be detected.

A main problem with this, is that the fiber can also be distorted by temperature changes which can cause uniform deformation. The polarization properties of light can be used to distinguish between unaxial deformation caused by stress, and uniform deformation caused by temperature effects. This project aims to polarize electromagnetic waves by the means of an antenna. Finite element models have already shown a correlation between the electromagnetic field, the presence of a double loop antenna and specific modes of electromagnetic waves. This was done by the previous iteration of this research project. This project aims to test the most promising antenna design from the previous iteration in macroscopic scale. Furthermore, the polarization effects of the antenna are aimed to be modeled in Comsol.

The results of the macroscopic setup indicates that an loop-antenna can absorb certain polarizations of radio waves with a frequency of 1550 MHz. In addition, the Comsol model shows that the designed antenna absorbs the largest possible amount of energy when the magnetic field oscillates vertically in to the antenna.

The recommendation for successive project consist of more macroscopic measurements and microscopic measurements including real optical fibers.

Fontys tutor Urs Wyder
Lotte Spanjers
Project group
Tom Reuvers
Twan van der Zanden
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Company: Fontys

Project no 4 Heartsink tool

Minor The project is conducted in the name of Fontys Hogescholen
in the third year of the education named Applied Physics.
Title **The heat sink tool.**
Subtitle The build of a heat sink tool which can be used to find out which heat sink is suitable for the user, and it has an educational purpose for people who want to learn more about heat sinks.

Introduction
The assignment of this project was to build a heat sink calculating tool in excel. With the tool the user can adjust the geometrical parameters, the ambient temperature and the total power through the heat sink to find a heat sink that is suitable for his application. The tool is created for educational purpose.

Project description
In the beginning of the project, we needed to set some targets for our model that are realistic and doable in the limited time we had. The targets that are chosen were based on three different concepts. Within the first concept we created a starting model that had almost all the components we wanted in the end but with basic formulas. Over the next two concept we added complexity, fin efficiency and structure to optimize our model.
The hardest part of the project was keeping structure in the model while working on it with four men at the same time and making sure everybody uses the same parameters. Now and then during the project we had to adjust some formulas because different variables were used for the same parameter. Later, in the project we developed more structure well working together so these mistakes became rare.
The targets that we set in the beginning of the project are almost all applied in the model. The only one that we miss is optimalisation. With this function the user can enter a geometric where in the heat sink must be build and the model calculates the most efficient heat sink for this situation. In the beginning we set this target as an optional option and due to lack of time the option is not installed.
At the moment the model can calculate base temperature, fin efficiency and thermal resistance of the heat sink that is defined by the user.

Fontys tutor Bart Smit

Project team J van Gelder, M Smulders, R van Beunigen, R Bens

Company: Fontys and AA-lux-lighting Fontys
Nora Klaren AA-lux-lighting
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Project no 5 pattern recognition
Minor Applied Physics
Title **Pattern Recognition**
Subtitle Recognition of musical instruments based on audio data

Introduction
The assignment is to be able to recognize patterns in audio data. Our goal for this research was to identify musical instruments using Machine Learning algorithms. The intended value of the project is to get a better understanding how Machine Learning can effectively be used for these kinds of tasks.

Project description
The previous group already made an algorithm that is able to recognize musical notes played by a piano. We decided to go a different route and try to recognize instruments.
One of the biggest challenges was to find a suitable dataset for our problem with enough quality data and good labels. Another challenge was to get a good understanding of which audio features to use, how the model is making decisions based on these features and how to determine the importance of each feature.
The expectations were that we could recognize instruments based on monophonic audio data. We also expected timbre to be a key factor in the recognition.
We trained a support vector machine (SVM) model and a simple neural network with two different datasets. One dataset with only monophonic audio data and the other dataset with melodies played by a single instrument. On the first dataset the SVM model showed an accuracy of 85% and the neural network an accuracy of 93% Using the second dataset with the same method the SVM showed an accuracy of 94% and the neural network an accuracy of 99%. The difference in performance might be because of the different nature of the samples.

Fontys tutor André Dommels

Project team B Klinkenberg, B Kuppen, K Mulders

Company Fontys Technische Natuurkunde
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