<table>
<thead>
<tr>
<th>Date</th>
<th>Research Area</th>
<th>Presenter</th>
<th>Subject</th>
<th>Subject</th>
<th>Abstract</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 4, 2019</td>
<td>AGM</td>
<td>Marc Secanell</td>
<td>Annual State of the Lab Address</td>
<td>Research Area</td>
<td>Some preliminary results in gas phase (both experiment and modelling results) will be shown. In addition to this results are shown which confirm that transfer of gas from reactor to the testing bag does not affect the concentration of gas phase species. Finally, soot formation modelling will be presented analytically to give an idea as how we can model soot formation from gas phase to solid phase.</td>
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<tr>
<td>January 9, 2019</td>
<td>PEMFC/E Modeling</td>
<td>Ambuj Punia</td>
<td>Progress in Methane thermal cracking</td>
<td>Subject</td>
<td>This presentation will discuss some of the key issues that persist in polymer electrolyte membrane fuel cells (PEMFC) are electrochemical devices that convert the chemical energy of hydrogen into electricity through an electrochemical reaction of an hydrogen-containing fuel with oxygen. The result of this reaction is electrical energy, heat (thermal energy) and water, and consequently PEMFC are clean energy generators. Control systems play an important role in PEMFC technology. In this talk, different aspects related with the role of control technology in PEMFC will be described.</td>
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<tr>
<td>January 16, 2019</td>
<td>Cooling Tower</td>
<td>Lisa Clare</td>
<td>Cooling Tower Experimental Model Update</td>
<td>Subject</td>
<td>This presentation will briefly introduce the flywheel demonstrator and how measurements are taken to characterize its self discharge behavior. Empirical models are created from experimental data which are then used to quantify losses between zero and 5,000 RPM. Techniques of health monitoring will be also discussed in this presentation, and optical methods are proved to be more feasible.</td>
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<tr>
<td>January 23, 2019</td>
<td>PEMFC/E Experiments</td>
<td>Luis Padilla</td>
<td>EIS results for computational model</td>
<td>Subject</td>
<td>A summary of the latest experiments and results of EIS and hysteresis for computational model.</td>
</tr>
<tr>
<td>January 30, 2019</td>
<td>PEMFC/E Modeling</td>
<td>SeongYeop Jung</td>
<td>Comparison of simulation results of sintered Ti in PNM and FCST</td>
<td>Subject</td>
<td>Proton Exchange Membrane Fuel Cells (PEMFC) are electrochemical devices that convert the chemical energy of hydrogen into electricity through an electrochemical reaction of an hydrogen-containing fuel with oxygen. The results of this reaction is electrical energy, heat (thermal energy) and water, and consequently PEMFC are clean energy generators. Control systems play an important role in PEMFC technology. In this talk, different aspects related with the role of control technology in PEMFC will be described.</td>
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<td>February 6, 2019</td>
<td>PEMFC/E Modeling</td>
<td>Prof. Ramon Costa</td>
<td>Control and Energy Management of PEM Fuel Cell Systems</td>
<td>Subject</td>
<td>This presentation will cover the basics of the pore-size-distribution-based model for flows in porous media used in OpenFCST. Some new statistical and conceptual details will be discussed in detail.</td>
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<tr>
<td>February 13, 2019</td>
<td>Cooling Tower</td>
<td>Alex Jarauta</td>
<td>Efficient fluid flow solvers in OpenFCST</td>
<td>Subject</td>
<td>The new fluid flow solvers based on the Schur complement model for the flow in the tower will be presented.</td>
</tr>
<tr>
<td>February 20, 2019</td>
<td>PEMFC/E Experiments</td>
<td>Clara Koffler</td>
<td>Final presentation</td>
<td>Subject</td>
<td>This presentation will cover a brief introduction to the numerical modeling of cooling towers. The focus will be on various zones of the tower and the respective models that will be used in the current study. Some preliminary data to support the need for turbulence modeling for the air flow in the tower will be presented.</td>
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<tr>
<td>February 27, 2019</td>
<td>PEMFC/E Modeling</td>
<td>Aslan Kosakian</td>
<td>Numerical Analysis of Counter-flow Wet-Cooling Tower using the augmented model</td>
<td>Subject</td>
<td>This presentation will cover the basics of the pore-size-distribution-based model for flows in porous media used in OpenFCST. Some new statistical and conceptual details will be discussed in detail.</td>
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<td>March 6, 2019</td>
<td>Cooling Tower</td>
<td>Prashanth Karupothula</td>
<td>CFD analysis of multi-component heat and mass transfer in wet cooling tower</td>
<td>Subject</td>
<td>Program UTEC-Harvard SEAS, where the general goal was to develop a solution that addresses the problem of informal gold mining in Madre de Dios Region. We designed a tool for soil nutrient analysis to boost agriculture as an economic alternative to gold mining. The result of this program was a prototype of a device capable of measuring the amount of phosphorus on the soil.</td>
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<tr>
<td>March 13, 2019</td>
<td>PEMFC/E Experiments</td>
<td>Elena Ezquerra</td>
<td>Problematic of informal gold mining in the Peruvian Amazon Basin</td>
<td>Subject</td>
<td>This presentation will briefly introduce the flywheel demonstrator and how measurements are taken to characterize its self discharge behavior. Empirical models are created from experimental data which are then used to quantify losses between zero and 5,000 RPM. Techniques of health monitoring will be also discussed in this presentation, and optical methods are proved to be more feasible.</td>
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<td>April 10, 2019</td>
<td>PEMFC/E Experiments</td>
<td>Hao Xu</td>
<td>Experimental Measurement of Mass Transport Parameters of Gas Diffusion Layer and Catalyst Layer in PEM Fuel Cell</td>
<td>Subject</td>
<td>Program UTEC-Harvard SEAS, where the general goal was to develop a solution that addresses the problem of informal gold mining in Madre de Dios Region. We designed a tool for soil nutrient analysis to boost agriculture as an economic alternative to gold mining. The result of this program was a prototype of a device capable of measuring the amount of phosphorus on the soil.</td>
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<td>May 8, 2019</td>
<td>Cooling Tower</td>
<td>Aditya Kodkani</td>
<td>Numerical Analysis of Counter-flow Wet-Cooling Tower using the augmented model</td>
<td>Subject</td>
<td>This presentation will briefly introduce the augmented model to study the thermodynamic properties of the cooling tower. This model is extended to study the rain and spray zones in the cooling tower. Further, I will be discussing the performance of the cooling tower in different ambient conditions.</td>
</tr>
<tr>
<td>May 15, 2019</td>
<td>PEMFC/E Experiments</td>
<td>Wei Fei</td>
<td>Experimental analysis of carbon matrix on mass transport properties</td>
<td>Subject</td>
<td>This presentation will cover the characterization of SGL samples with different carbon matrix content, i.e., SEM images, porosity, thickness, in-plane permeability and diffusivity.</td>
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<tr>
<td>May 29, 2019</td>
<td>PEMFC/E Modeling</td>
<td>Michael Moore</td>
<td>Numerical Modelling of Polymer Electrolyte Membrane Water Electrolisis</td>
<td>Subject</td>
<td>This presentation will discuss some of the key issues that persist in polymer electrolyte membrane water electrolysis. These issues include minimising hydrogen crossover, understanding mass transport losses, the mechanism of the OER and the degradation of catalysts and PTL. Numerical modelling will be used to attempt to shed light on some of these issues, with the main goal being able to accurately model polarisation curves and EIS data. Then what-if analysis will be used to determine limiting processes and optimise the construction of the cell and its operating conditions.</td>
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### June 12, 2019
- **Cooling Tower**
- **Alex Jarauta**
- A transient Lagrangian model for droplets on substrates with moving contact lines

### June 19, 2019
- **PEMFC/E Experiments**
- **Scott Strobakken**
- Current State of Affairs of Anion Exchange Membrane Water Electrolysis within the ESDLab

### June 26, 2019
- **Cooling Tower**
- **CT group members**
- Rehearsal for ESDLab - ICT meeting

### July 10, 2019
- **PEMFC/E Modeling**
- **Vaishnavi Kale**
- Optimal design of flywheel rotors used for short duration grid energy storage

### July 17, 2019
- **PEMFC/E Experiments**
- **Manas Mandal**
- Measurement of the Protonic Conductivity of PEM Water Electrolyzer Electrodes

### July 24, 2019
- **PEMFC/E Modeling**
- **Ambuj Punia**
- Supervisory committee presentation

### July 31, 2019
- **Cooling Tower**
- **Alex Jarauta**
- A compressible fluid flow model for channels and porous materials

### August 14, 2019
- **PEMFC/E Experiments**
- **Luis Padilla**
- Experimental testing of separate catalyst layers PEM unitized regenerative fuel cells (URFC)

### August 21, 2019
- **PEMFC/E Modeling**
- **Elizabeth Gierl**
- Comparison of pore network and continuum model predictions in 3D microstructure

### August 28, 2019
- **PEMFC/E Modeling**
- **Prashanth Karupothula**
- CFD analysis of fluid flow in an induced draft cooling tower

### September 4, 2019
- **PEMFC/E Experiments**
- **Danica Sun**
- Operating power losses in a flywheel energy storage system

### September 9, 2019
- **PEMFC/E Modeling**
- **Aslan Kosakian**
- An Open-Source Transient Model for Numerical Characterization of Proton Exchange Membrane Fuel Cells

### September 16, 2019
- **PEMFC/E Experiments**
- **Wei Fei**
- Effect of GDL carbon matrix on its microstructure and on transport and performance for PEMFCs

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**PEMFC/E Experiments**

- PEMFC/E Modeling
- CT group members
- Rehearsal for ESDLab - ICT meeting

**Supervisory committee presentation**

**Arduino seminar**

- Arduino seminar starts at 2 pm

**CFD analysis of fluid flow in an induced draft cooling tower**

- Cooling tower is a heat exchanging device which uses ambient air to cool hot process water from industrial plants. The air enters at the bottom of the tower and abruptly changes the direction due to which a stagnation zone is observed in the tower. This, in turn, results in non-uniform distribution of air at the fill inlet which will have adverse effects on the final performance of the tower. In this talk, the governing equations, the domain, the boundary conditions and the fluid flow in the tower will be discussed.

**An Open-Source Transient Model for Numerical Characterization of Proton Exchange Membrane Fuel Cells**

- An overview of the fuel-cell model validation in the literature will be given. The importance of considering multiple experimental data sets coming from different characterization techniques in the process of the model validation will be highlighted. A transient fuel-cell model will be presented that is capable of reproducing the experimental i-V, i-R, and EIS data.

**Effect of GDL carbon matrix on its microstructure and on transport and performance for PEMFCs**

- This presentation will introduce the hypothesis that the carbon matrix content in SGL GDLs will lead to different PEMFC electrochemical performance. In order to validate this hypothesis, porosity, PSD and carbonmatrix content are measured by MIP test; the gas transport properties, i.e., permeability and diffusivity, are measured by diffusion bridge; water cross-over are measured by water balance using RH&T sensor.
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<thead>
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<tr>
<td>September 23</td>
<td>PEMFC/E Modeling</td>
<td>Tobias Neef</td>
<td>Fluid flow in polymeric multi-channel membranes with anisotropic properties An overview about the flow phenomena inside the porous structure of an ultrafiltration membrane is presented. They are used for pre-treatment of seawater in desalination plants. New technologies in the field of membrane fabrication allow new types of membranes. My project observed the behaviour of a polymeric multi-channel membrane (invented 2002, first paper in 2005). The project has new insights what happens between the channels during the filtration and backwashing process.</td>
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<td>September 30</td>
<td>PEMFC/E Experiments</td>
<td>Scott Strobakken</td>
<td>Dynamic Light Scattering Analysis of Carbon Based Inks The theory behind dynamic light scattering (DLS) experiments is to be presented along with a general procedure for analyzing the quality of data obtained from a DLS experiment. Specific cases of acceptable DLS data will be given for carbon and Pt</td>
</tr>
<tr>
<td>October 7</td>
<td>PEMFC/E Modeling</td>
<td>Aditya Kodkani</td>
<td>Numerical modeling of heat and mass transfer of a mechanical draft cooling tower In this presentation, I will be discussing the augmented model and its potential to represent the contribution of heat rejected and mass evaporated in different zones. The developed augmented model is validated against the standard Poppe and Merkel method present in the literature. Further, the model is validated against the field data and the performance of the cooling tower is studied under hot-dry, hot-humid, Cool-dry and Cool-humid conditions.</td>
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<td>October 21</td>
<td>PEMFC/E Experiments</td>
<td>All experimentalists</td>
<td>Fuel cell fabrication and testing tutorial</td>
</tr>
<tr>
<td>November 18</td>
<td>PEMFC/E Modeling</td>
<td>Vaishnavi Kale</td>
<td>Simultaneous shape, size and speed optimization for maximizing the energy capacity of a flywheel rotor The simultaneous optimization of the shape, size and speed of a flywheel rotor is presented as a novel approach to improve the energy storage capacity of a flywheel in a grid application. Two commercially manufactured FESS rotors are used as case studies to demonstrate the benefit of using the proposed optimal design process. Some new functionalities implemented in the OpenFCST framework to perform the above studies, such as, 1) iterative remeshing of a parameterized 2D rotor geometry (with error handling) using pyfcst and Gmsh, 2) adaptive mesh refinement during optimization (iterations to ensure convergence of a stress constraint and 3) setting up OpenFCST based optimization studies on an HPC cluster, are also briefly discussed during the presentation.</td>
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<td>December 2</td>
<td>PEMFC/E Experiments</td>
<td>Lisa Clare</td>
<td>Rehearsal for the M.Sc. thesis defence The classic methods of designing and analysing cooling towers are 0D or 1D in their formulation, and neglect the deleterious effects of maldistribution of air and water. In the work presented here, a lab-scale cooling tower has been designed and built, allowing for the experimental measurement of 3D airflow phenomena which have until now only been assessed with CFD. The major design considerations of the experimental model are discussed. Measurements reveal unique features of the internal air flow field, including zones of recirculation, homogenizing elements, and the interaction between airflow disturbances in close proximity. Pressure losses induced by the fill and drift eliminator are measured, and discrepancies relative to the manufacturer’s predictions are observed and discussed.</td>
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<td>December 9</td>
<td>PEMFC/E Experiments</td>
<td>Lisa Clare</td>
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