Date	Research Area	Presenter	Subject	Abstract
January 12, 2018	AGM	Marc Secanell	Annual State of the Lab Address	
January 19, 2018	PEMFC/E Modeling	Max Kruse	Parallelization of FE application core and Schur complement solver	An extension of the Schur complement solvers for parallel computations is presented. The modifications in the different classes are discussed as well as the increase in computational speed. Additionally, the resulting generalization of several routines for the FE computations is reflected upon.
January 26, 2018	PEMFC/E Experiments	Luis Padilla	Bifunctional electrodes for unitised regenerative fuel cells	Article review: The effects of different configurations and compositions of pt and IrO2 electrodes for the oxygen reaction of unitised regenerative fuel cells (URFC). Bifunctional electrodes studied under different combinations of catalyst mixtures, multilayer arrangements and segmented configurations.
February 2, 2018	PEMFC/E Modeling	Elaf Mahrous	Lagrangian-Eulerian approach for analyzing droplet dynamics and surface tension forces.	Highlighting the importance of the Lagrangian-Eulerian approach in analyzing droplet dynamics and surface tension forces. The presentation will share the two basic governing equations (continuity and momentum), indicating the surface tension forces and effects. Then, it will highlight how these equations have been utilized now in Kratos (both in virtualbox, and latest version)
February 9, 2018	PEMFC/E Experiments	Danica Sun	Mathematical Modelling, Design, Fabrication and Testing of Flywheels for Grid-Scale ES	--> A brief introduction on the numerical modeling and optimization of flywheel systems. Analyze and compare metal and composite flywheels in terms of their specific energy storage and energy storage per unit cost. --> Introducing the experimental setup of a flywheel demonstrator and discussing the possible contributing factors to its self-discharge behavior during operation.
February 16, 2018	PEMFC/E Experiments	Lisa Clare	Cooling Tower Merkel Analysis and Experimental Model	1. Experimental model's purpose, basic design and features, and current construction progress. 2. Overview of the widely-used Merkel method of analysis and its implementation in CoolIt.
February 23, 2018	PEMFC/E Experiments	Lukas Baron	Introduction to my tutorial and Fuel Cell performance with different anode side loading	Introduction to the Tutorial on how to prepare Ink, print CCMs and test them in the ESDLab and presenting the first results of tests with different anode side loadings (0.025; 0.05; 0.1 and 0.15 mg Pt/cm^2)
March 2, 2018	PEMFC/E Modeling	Seongyeop Jung	Introduction to OpenPNM and simple example	Introduction to OpenPNM which is open source software to perform pore scale simulation and written in python. The presentation will cover how it stores data and simple example of permeability simulation will be introduced to help understand how it works.
		Aslan Kosakian	Computation of total and capacitive current density in transient PEMFC models in OpenFCST	A short overview of the state of the transient models in OpenFCST and discussion of the recent results in computing the total and capacitive current density components.
March 9, 2018	PEMFC/E Experiments	XueHai Tan		
March 16, 2018	PEMFC/E Modeling	Mayank Sabharwal	Electrochemical performance in partially saturated catalyst layers	The presentation will provide insight into the new framework and application for microscale reactions that has been developed in OpenFCST.
March 23, 2018	PEMFC/E Experiments	Hao Xu	Through-plane permeability and diffusibility of gas diffusion layer	1. A quick review of setup for through-plane permeability and diffusivity, as well as governing equations and boundary conditions. 2. Update on the through-plane experimental results, including permeability and diffusibility of 34BA, Toray90(5%PTFE) and Toray90(20%PTFE) , along with the comparison with other literature.
March 29, 2018	PEMFC/E Experiments + Modeling	Aidan Heaman	Modeling transient operating conditions to simulate realistic fuel cell operation	The importance of transient modelling in predicting fuel cell performance. Emphasis on the difference between conventional steady-state models and the reality of fuel cells used in practical applications. (Mid-term presentation for the Dean's Research Award)
		Nilay Patel	Stochastic Microstructure Generation of Catalyst Layers for a Proton Exchange Membrane Fuel Cell	Understanding how the micro-structure of the catalyst layer of a fuel cell affects the electro-chemical reactions is critical for optimizing the catalyst layer. The focus of this research project was to develop an optimized Python code which generates stochastic micro-structures of the catalyst layer to use in parametric studies, such as the effects of carbon particle size.
		Mia Thomas	Mesh generation for flywheel numerical modeling	In this project, several different geometries of a flywheel have been generated using a 3D finite element mesh generator, Gmsh. These meshes will be imported into OpenFCST to run simulations. From these simulations, the effect that the geometry has on the stress and strain of the flywheel operating at high speeds can be visualized, and will be used to optimize shape of the flywheel along the radius
		Christopher Keen	Designing a drop-on-demand mezzo scale piezoelectric inkjet setup for jet analysis	In order to construct an effective inkjet setup, for use in testing, the proper hardware and software must be properly utilized. This includes functional drive electronics such s the Jetdrive III, a dispensing device, and corresponding control software such as Jetserver IV. This presentation will discuss the basic inkjet setup as well as operation and procedure.

April 6, 2018	Cooling Tower	Alex Jarauta	Incompressible fluid flow modeling with water vapor transport	The new Advection-diffusion equation class in OpenFCST will be presented. This new class is needed to model water vapor in cooling tower applications, but it can be extended to other problems. The main features of the class will be reviewed, as well as its current issues.
April 13, 2018	PEMFC/E Experiments	Wei Fei	The PSD and porosity calculation by Quantachrome PoreMaster	The calculation basics for PSD and porosity are defined firstly, and then the PSD and porosity for SGL 24 series, 29 series, 34BA, 39 series are obtained. More than that, a flowchart is given to illustrate how to get the PSD and porosity for the catalyst which is printed on substrate.
April 20, 2018	PEMFC/E Modeling	Jie Zhou	Analysis of Multi-Phase Flow in Polymer Electrolyte Fuel Cells Using a Mixed Wettability Pore-Size Distribution Model	In this work, a multi-dimensional, non-isothermal, two-phase model is developed, where the microstructural detail is accounted using a mixed wettability pore size distribution (PSD) model. The PSD model is used to predict local water saturation based on gas and liquid pressure, and can be used to study the effect porous layer microstructure and wettability on two-phase flow. The proposed model is validated by comparing to experimentally measured electrochemical performance data under various operating conditions. Water accumulation in catalyst layer and gas diffusion layer are also compared to the neutron and X-ray imaging data and shown to be in agreement. After model validation, the proposed model has been used to study: (a) the effect of catalyst layer microstructure and wettability on fuel cell performance and (b) the role of the micro-porous layer (MPL).
April 27, 2018	Cooling Tower	Prashant Karaputhula	Numerical modelling of Cooling tower	1. A brief introduction of cooling tower and the factors that affect it's performance 2. Different types of fills and the analysis of heat and mass transfer at fill surface – Merkel method. 3. Brief discussion on Coolit results validated against Klopper's results
May 18, 2018	Cooling Tower	Everyone	ICT - UAlberta NSERC CRD meeting	
June 8, 2018	PEMFC/E Modeling	Vaishnavi Kale	Linear elasticity in OpenFCST used for flywheel numerical simulations	The equation class for linear elasticity (2D and 3D) is implemented in OpenFCST and used to solve a quasi-static rotating flywheel problem. The effect of flywheel shape on the stress distribution and performance is discussed, and topology optimization algorithms for flywheel geometry optimization are reviewed,
June 15, 2018	PEMFC/E Experiments	James Kracher	Influence of membrane thickness and cell construction on water crossover	Experimentally measured water flux across the membrane for seven different cell architectures will be presented. Cells were assembled with different membrane thicknesses and with and without the presence of an MPL.
		Xavier Perez	Impact of Pt loading on Proton Exchange Membrane Hydrogen Fuel Cells Performance	This study is focused in the Pt loading effect in the electrodes of the Proton Exchange Membrane in a Hydrogen Fuel Cell. It has been tested different CCMs with different loading on the anode side and cathode side.
June 29, 2018	Cooling Tower	Adytia Kodkani	Numerical modeling of a cooling tower	1. Introduction to the cooling towers and different parts of the cooling tower 2. A brief discussion on Klimanek method
July 6, 2018	PEMFC/E Experiments	XueHai Tan		
July 13, 2018	PEMFC/E Modeling	Ambuj Punia	Numerical Modelling of methane thermal decomposition	The presentation will focus on the brief introduction on numerical modelling of thermal decomposition of methane. A zero dimensional model(gas phase) for a perfectly mixed reactor will be presented and results will be shown which are obtained using cantera. Comparison of different reaction mechanisms and their validation to the reference paper will also be included in the presentation.
July 20, 2018	PEMFC/E Modeling	Mayank Sabharwal	Impact of local saturation on transport and performance of fuel cell electrodes	Water management is critical to the performance of fuel cells at high current densities. In this study, impact of local saturation on the transport in GDL and CL and performance of the CL is analyzed.
		Aslan Kosakian	An Open-Source Multi-scale Transient Model for Numerical Characterization of PEMFCs	Fuel cell characterization techniques, such as polarization curve experiments and electrochemical impedance spectroscopy, are, by their nature, time-dependent measurements. Therefore, in order to improve the understanding of the physical phenomena taking place in the cell during those experiments, transient modeling is required. In this work, an open-source, multi-scale, dynamic model of a PEMFC is presented that can be used for numerical characterization of fuel cells and to study the effects of operating conditions, material properties, and cell composition on the cell performance.
	Cooling Tower	Elaf Mahrous	Lagrangian-Eulerian approach for analyzing droplet dynamics and surface tension force	Modeling a meso-scale droplet requires a reliable modeling tool; beside, it is important to understand the physics behind the surface tension phenomena. Here, I am going to share the basic physics behind the surface tension phenomena, indicating its importance and applications. Then, I will introduce the Lagrangian-Eulerian approach for analyzing droplet dynamics and surface tension force, using Kratos Multi-physics open source software.
July 27, 2018	PEMFC/E Experiments	Manas Mandal	Understanding the impact of catalyst layer microstructure on losses of inkjet printed PEM electrolyzer	Practice session for candidacy exam

August 3, 2018	PEMFC/E Modeling	Michael Moore	Update on FES T06-P04: Utility-Scale Energy Storage. Mathematical modelling of an acidic electrolyser cell	This presentation will be given as an update on the FES project that I'm working on. In it, I will describe the work done so far, as well as future work. In particular, I'll be talking about the development of a 0-D electrolyser model that has been built using a Python GUI, some of the analysis needed as its input and some results and issues arising from the model. I'll also talk about the model that's been implemented for the HER in OpenFCST, and some of the changes that will be made to allow us to model electrolysers in OpenFCST
August 10, 2018	Cooling Tower	Alex Jarauta	Advection-diffusion equation modeling for water vapor transport	The new advection-diffusion equation class in OpenFCST will be reviewed. Boundary conditions to ensure the well-posedness of the problem will be discussed, and results will be compared to the Kerkhof-Geboers formulation for multi-component flows.
August 17, 2018	PEMFC/E Experiments	Luis Padilla	Experimental data with different parallel channel configuration designs	Experimental results comparison between two different parallel channel bipolar plates designs. The effect of the manifold distance in gas crossover of the cell using different membrane thickness will be presented.
August 24, 2018	PEMFC/E Modeling	Seongyeop Jung	Modelling GDL material in OpenPNM	Some approaches for modelling the GDL material in Openpnm will be introduced. Advantages and disadvantages of each approach will be discussed. Simulation results of material properties such as permeability, diffusivity will be compared to the experimental results.
	PEMFC/E Experiments	James Kracher	Experimental Analysis of Transient Water Fluxes in PEM Fuel Cells	Thesis defense rehearsal. Complete presentation detailing my research at the ESDLab. Will discuss the development and validation of an experimental setup for monitoring water distributions in a fuel cell. Further insight will be provided regarding the effect of MPL addition on water movement relative to the membrane thickness
August 31, 2018	Cooling Tower	Lisa Clare	Cooling Tower Experimental Model – Construction Status and Operation	Update on the physical construction of the experimental model, and a walkthrough of the most recent design and its corresponding operating procedure. First batch of airflow measurements for a dry cooling tower will also be presented.
	PEMFC/E Modeling	Campbell Rea	Stochastic Microstructure Generation and Analysis	The algorithmic descriptions of several stochastic generators that have been developed over the course of the summer are discussed. The different approaches used within each of the examples will be compared with those developed in literature and the various advantages and disadvantages will be weighed.
September 7, 2018	PEMFC/E Experiments	Danica Sun	Numerical modeling of flywheel using different softwares and strain measurement techniques	1. Two different rotor designs with similar mass will be simulated using 3 different softwares (OpenFCST, Solidworks and Ansys). Simulation results for each design will be compared based on the same material properties of the flywheel rotor. Since the results are mesh dependent, coarse and fine mesh will be considered for each case. 2. Possible solutions for measuring strains in a rotating disk at 5000 rpm max. will also be discussed.
September 14, 2018	PEMFC/E Modeling	Aslan Kosakian	Rapid EIS: an efficient approach to numerical impedance spectroscopy	The traditional approach to performing electrochemical impedance spectroscopy (EIS), i.e., application of a small sinusoidal voltage (or current) perturbation and measurement of the current (or voltage) response, is time-consuming as impedance at each frequency value is a result of a separate simulation or experimental measurement. In this presentation, an algorithm for performing rapid EIS will be presented. The presented method allows to extract impedance at the whole frequency range from a single simulation.
September 21, 2018	Cooling Tower	Alex Jarauta	Advection-diffusion equation modeling for mass and thermal transport	The advection-diffusion equation classes for mass and thermal transport in OpenFCST will be reviewed. Boundary conditions to ensure the well-posedness of the problem will be discussed, as well as some preliminary results. Some recent tools to output the relative humidity and the average mass fraction of the solute at the outlet will also be described.
September 28, 2018	PEMFC/E Experiments	Scott Storbakken	Introduction to Anion Exchange Membrane Water Electrolysis	Advantages that anion exchange membrane water electrolysis (AEMWE) has over conventional alkaline water electrolysis, as well as proton exchange membrane water electrolysis (PEMWE), respectively include the omission of a circulating caustic liquid electrolyte and expensive titanium end plates. In addition to discussing further advantages of AEMWE, the challenges facing the technology and the plans to construct an AEMWE test-station within the ESDLab will be presented.
	PEMFC/E Modeling	Mayank Sabharwal	Microstructural analysis of transport in fuel cell electrodes	This presentation is a rehearsal for the ECS talk that I will be giving on Sunday. It will cover some of the results on the diffusivity and performance of fuel cell electrodes from a microstructural perspective.
October 5, 2018	PEMFC/E Modeling	Mayank Sabharwal Aslan Kosakian	Updates on the ECS Meeting in Cancun, Mexico	
October 12, 2018	Cooling Tower	Prashant Karaputhula	Progress in CoolIT	In this presentation, a brief review on the errors associated with CoolIT are discussed. Inconsistency in the solution due to initial guesses is taken care by incorporating new emperical relations for evaluating initial guesses. Inorder to increase the robustness of CoolIT, a 3 equation model is implemented circumventing the necessity for air-vapor mass flow rate. Fill library is updated and solution checks are implemented so that CoolIT warns the user of possible errors.

October 19, 2018	PEMFC/E Experiments	Hao Xu	An experimental method for measuring through-plane permeability and Knudsen diffusivity of catalyst layer	Introduction to a method of measuring through-plane permeability and Knudsen diffusivity of catalyst layer. Some experimental results of 20%Pt/C with 20%, 30% and 40% Nafion content will also be shortly discussed
October 26, 2018	PEMFC/E Modeling	Vaishnavi Kale	Discontinuities in the stress distribution of a linear elastic body and 2D stress constrained topology optimization	The smoothing of discontinuous nodal solution gradients in FEM, as well as typical causes of such discontinuities are discussed. This process is necessary when the gradient based nodal stresses and strains in a linear elastic body are used in applications such as topology optimization. An example of 2D topology optimization of a beam (by Sigmund et al.) is discussed and modified to include stress constraints, which are necessary to optimize the flywheel geometry.
November 2, 2018	PEMFC/E Experiments	Wei Fei	The determinations of PSD, porosity, thickness, density, tortuosity and diffusivity for the separate sections of SGL BC samples	The SGL BC samples were firstly divided into pure GDL section, GDL/MPL mixed section and pure MPL section, and then the PSD, porosity, thickness, density, tortuosity and diffusivity were calculated for each divided section, where the diffusivity was determinated corresponding to the Knudsen Number.
November 9, 2018	Cooling Tower	Everyone (from CT)	Rehersal for the ICT-ESDLab Meeting	
November 16, 2018	PEMFC/E Experiments	Luis Padilla	Experimental investigation of bifunctional catalyst layer fabrication by inkjet printing technique for unitized regenerative fuel cells	Practice session for the candidacy exam
	Cooling Tower	Alex Jarauta	A new implicit finite element model for the analysis of droplet dynamics	This presentation is a rehearsal for the APS talk that I will be giving on Sunday.
December 7, 2018	PEMFC/E Modeling	Michael Moore	Multiple kinetics in OpenFCST - Results and Implementation	Currently OpenFCST only allows for the modelling of the primary reactions occurring with a fuel cell, i.e. the redox reaction that produces the usable current. However a number of other reactions are known to proceed during operation that can impact the efficiency and durability of the fuel cell. To be able to model these reactions, OpenFCST needs to be extended to allow for multiple reactions to be considered within an electrode, requiring a major change in how it handles kinetic objects and solution variables. These changes will be described, along with preliminary results from modelling hydrogen crossover to the cathode and its subsequent oxidation.
December 14, 2018	Additive Manufacturing	Baltej Rupal	A Geometric Quality Assessment Framework for Metal Additive Manufacturing Processes	Practice session for the candidacy exam
December 18, 2018	PEMFC/E Experiments	Manas Mandal	Optimization of an anode catalyst layer of a PEM water electrolyzer	Optimization of anode catalyst layer (CL) of PEM water electrolyzer is important because majority of performance loss is attributed to anode CL overpotential and the cell resistance. Key factors affecting the CL performance are catalyst loading and Nafion ionomer content in the CL. There are only five publications on optimization of Nafion ionomer in the literature and It was observed that the optimized ionomer content varies from 5 - 75 wt.%. This variation in optimized ionomer content may be attributed to different surface area of the CL due to different catalyst used in those publications. Our hypothesis is that optimized ionomer content is depend on the surface area of the CL. A higher surface area would require a higher Nafion loading to coat all particles in the electrode. Whereas, a lower surface area would require lower Nafion loading. Catalyst coated membrane fabricated using TKK IrO2 catalyst with 5, 15 and 25 wt.% Nafion loading and the analysis of the results will be presented.