Abstracts 230113

Axel Martin - Automation of a rotating bed reactor for PFAS remediation - Spinchem

Properties such as being water and oil repellent and being heat resistant makes PFAS useful in a wide range of products. Since they do not break down in the environment, PFAS pollution makes it way back into drinking water and seafood. They can have negative health effects and standard water treatment facilities can not remove these substances. Spinchem has combined its RBR technology with a mixed bed resin to construct a water treatment system to treat PFAS polluted water. In this project, I have automated the system to make it more economically viable and investigated the efficiency of the system. This was done by experimenting with different RBR bed geometries and RPM of the RBR and measuring the time and energy cost for each setup. The PFAS remediation process was modelled with the process of deionizing water for fast and accurate measurements and the experiments were performed with an RBR S14 and Purolite MB400 resin. The results indicated that the geometry of the RBR bed did not show results that could not be achievable by adjusting the RBR RPM. The RBR speed experiments showed that between 125 RPM and 300 RPM, the energy cost increased linearly with reduced time. The process speed with an RBR RPM of 100 was significantly longer than the other speeds. A cost analysis indicated that the major factors to the operational cost of the system is the resin cost and capacity.

Ketill Hjartarson – Localization and Mapping for Autonomous GPR Survey Robot – Guideline Geo

To map the subsurface Ground Penetrating Radar (GPR) can be used in a non-invasive way. It is currently done manually by pushing a wheeled device on a handlebar. This thesis suggests an alternative method using an integrated autonomous solution. To accomplice that: several sensors were fused to give the robot perception of the world, the ability to localize itself within it and plan a path to reach the goal. Detecting algorithms were implemented and tested to ensure the robot could handle a dynamic and complicated world. The results showed that the robot could independently navigate in a grid pattern conducting GPR surveys while avoiding obstacles and finding a safe route. All this will allow for collecting GPR data with precise localization measurements and in paths more detailed than a human operator could. In addition, it enables the operator to be at a safe distance in dangerous environments and to search large areas.

Nils Henriksson – Numerical Simulations of Ultrafast Dynamics in Plasmonic Nanostructures – Department of Physics

Plasmonic nanosized particles enhances the interaction between light and matter due to the localised surface plasmon resonance effect, with potential applications such as all-optical transistors and thereafter optical computers. Commonly, dynamics of nanoparticles optical properties are assessed via pump-probe spectroscopy, where the transmitted/reflected light of a probe laser interacting with the structure is monitored. When the structure is pumped by another laser, the optical properties changes which in turn alters the interaction between the probe and the structure. That methodology can be used for other applications as well, e.g. all-optical switching. This study focuses on an implementation of a numerical finite element method model simulating a pump-probe experiments with the purpose of predicting effects of different geometries and evaluating experimental data. The simulations are split into three parts. Initially, periodically spaced nanoparticles are energised by the pump laser. Then the model estimates the internal thermal dynamics of the energised nanoparticles and in turn determines the change in complex permittivity. Lastly, the probe-matter interaction is modelled. In order to evaluate the model, simulations of periodically spaced gold dimer nanoparticles in air were performed to investigate how dimers affect transmitted light. For a probe light polarized 30 degrees against the axis parallel to the dimer, an initial clockwise polarization rotation of 7.6 degrees was achieved. After pumping the system at resonance frequency, the polarization rotated 6.9 degrees counterclockwise over the span of 100 fs, indicating a potential switching mechanism. This behaviour is in agreement with other works.

Veronica Lundgen - Artificial transactional data generation for benchmarking algorithms - Infobaleen

Modern retailers have been collecting more and more data over the past decades. The increased sizes of collected data have led to an increase in demand for data analytics, through expertise as well as analytic tools. Both of these are things that the Umeå-founded company Infobaleen provides. One recurring challenge when developing tools for this application is the data itself. Difficulties in finding relevant open data sets have led to a rise in the popularity of using synthetic data. By using artificially generated data, developers gain more control over the input when testing and presenting their work. However, most methods that exist today either depend on real-world data as input or produce results that look synthetic and are difficult to extend. In this thesis, I explain my method specifically designed to stochastically generate synthetic transactional data. I first observed real-world data provided by Infobaleen, to empirically determine suitable statistical distributions to use in my algorithm. I then modeled individual decision-making using points in an embedding space, where the distance between the points serves as a basis for individually unique probability weights. This solution creates data that is distributed similarly to real-world data and allows for retroactive data enrichment using the same embeddings. Conclusively the result is a data set that looks genuine to the human eye but is completely synthetic. Infobaleen now uses data generated with my introduced model, when presenting their product to new potential customers or partners.