ZEIT4500/4501/4297/4901/4902 Engineering Seminar Records

Student ID: z5364371

Student Name: Nicholas Liu

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| Topic of the Seminar: Neuromorphic Engineering: Biology – Inspired Sensing and Computing |
| Source of the Seminar: UNSW Canberra |
| Name(s) and organisation(s) of the speaker(s): A/Prof Gregory Cohen, Western Sydney University |
| Date or year of the seminar was given: 23rd Jul 24 |
| Date of the seminar been watched by the student: 23rd Jul 24 |
| Reflection on the seminar by the student (250-500 words):  Broad field – essentially how biology achieves things  Covers real world engineering from software to hardware architecture  Neuromorphic engineering is split into engineering an science, with the real world implications of developing engineering outcomes as well as scientific investigations into how biological investigations can lead to discoveries.  Recent news: neuromorphic engineering -> deep south neuromorphic super computer, large collection of neurons  Efficiency gains may be made by pre computing in sensors – there is pre computing in the retina as the nerves are not 1 to 1 to the brain, this is where efficiency will be made  WSU Neuromorphic Sensor, 2022, camera sensor that works closer to an eye then a digital camera. The data is event based which represents threshold sampling vs uniform sampling that is currently used. Standard cameras create a “perfect reconstruction” of the environment while threshold sampled neuromorphic sensors can be built to a specific type of task.  The neuromorphic sensors developed by this team only detect events, they can produce significantly more accurate data on motion without the large size of sampling the entire picture  How the cameras work: the camera clamps the voltage across the photo diode and filters the amount of voltage vs a standard camera that dumps the current across a capacitor to integrate – absolute light intensity is not measured, change instead is measured (temporal contrast sensor)  Due to the threshold sampling the camera can have very high level detail at low data rates, as the camera does not traditionally sample  The faster motion sensing camera in future could be used to trigger a high resolution camera like a high speed camera – this would significantly reduce the data load on the system  Applications and Reasoning:  Sturdy, low power, low heat, low data, high resolution and frame rate cameras  Makes it applicable for space and can observe movements at incredibly high fidelity  Challenges:  Data processing algorithms  Using neural networks to track different kinds of objects in event – based data |
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| Topic of the Seminar: Photodetectors for sensing |
| Source of the Seminar: UNSW Canberra |
| Name(s) and organisation(s) of the speaker(s): Haroldo Hattori |
| Date or year of the seminar was given: 30 Jul 24 |
| Date of the seminar been watched by the student: 30 Jul 24 |
| Reflection on the seminar by the student (250-500 words):  General outline is to summarise methods of sensing the external world:  Photodetectors convert light into electricity  Gas sensors  Strong coupling between light and matter  Photodetectors work through the photoelectric effect -> this is commonplace in day to day life as photo diode cirucits can generally only detect under 1100 nm, generally silicon has limits in wavelengths and sensitivity  2 types of photodetectors: semiconductor (PIN junction) -> diode, total current is sum of drift and diffusion current, metal-semiconductor interface, current through thermoionic emission  Results showed higher responses (I\_photo/P\_opt) over commercially available resources  “nano wire” photodetectors -> can be used in large arrays to generate further current  Photodetectors can do measurements between 280 and 1650 nm, looking at further improving this  Gas Sensors -> gases absorb light based on their concentration in the atmosphere – absorption spectra  Slot Waveguide as a gas sensor – existing literature  Neural networks and machine learning might  Project aims to detect toxic gas sources by combining robots and gas detectors  Rydberg atoms can be used in antennas through exciting electrons through a series of lasers and applying a microwave signal which can then be decrypted, this is important as they can be applied in ultrabroadband recievers (US Army) which can detect from DC to 1 THz.  Strong Coupling regime is a physical condition where the interaction between light and matter is so strong that they can exchange energy faster than they lose energy to their surroundings  Strong coupling can be boosted through various types of nano material combinations  Strong coupling is useful in laser applications |

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