Christopher Bruinsma | Independent Study Roadmap | Spring ‘22

Aims

The aims of this research are to a) investigate the effects of dark-current (thermal noise) on an image sensor by inducing the kind of heat that would be expected of a sensor in a near-sensor processing configuration, b) train a neural network using image samples taken from the dark-current-induced image sensor in various stages of noisiness, c) to compare the efficacy of training a neural network on near-noiseless images versus noisy images versus a mixture of both, and measuring well a common object can be identified by an image characterization neural network. The metric that would define how well the neural network has functioned is its task accuracy as was the case in both[1][2]. More on task a), the sensor should be heated in intervals of 5°C ranging from room temperature as the control to around 80° C as this was the thermal range of the sensor Kodukula et. Al. in figure 3[1]. In sum, the aims of this are to test a neural network approach to removing dark-current noise and verify its efficacy using a characterization neural network. This research aims to come up with a solution to the dark-current noise created by near-sensor processing and the final deliverable will be a paper reporting on the findings of this research and the hope is that we will have processed enough images to see a more effective neural network approach revealed.

This begs the question: what is the plan this semester?

Project Plan Independent Study

This is my tentative plan for the semester that takes into account the online portion of the semester.

Materials

- ☐ **A heat gun** to be used for inducing dark current noise
- ☐ **An image sensor** of some kind to be heated up (you mentioned something about a FLIR sensor, does this come with a lens?)
- ☐ **Infrared thermometer** for measuring the temperature of the image sensor
- ☐ **Imaging software to connect and capture images** (to interface with 2)
- ☐ **Neural Networks** (*how should these be implemented? Tensorflow? PyTorch?*)
    a) **Denoising Neural Network** (to be trained on noisy image data)
    b) **Image** (object detection) **neural network** (for characterization)
- ☐ **A set of common objects** to image (coffee mug, apple, water bottle)

Works Cited

[1] Dynamic Temperature Management of Near-Sensor Processing for Energy-Efficient High-Fidelity Imaging**.** Kodukula Et Al.

[2] Dirty Pixels: Towards End-to-End Image Processing and Perception Diamond Et. Al.