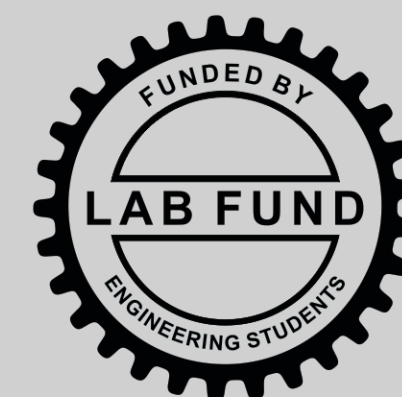


LUMBAR PUNCTURE DEVICE

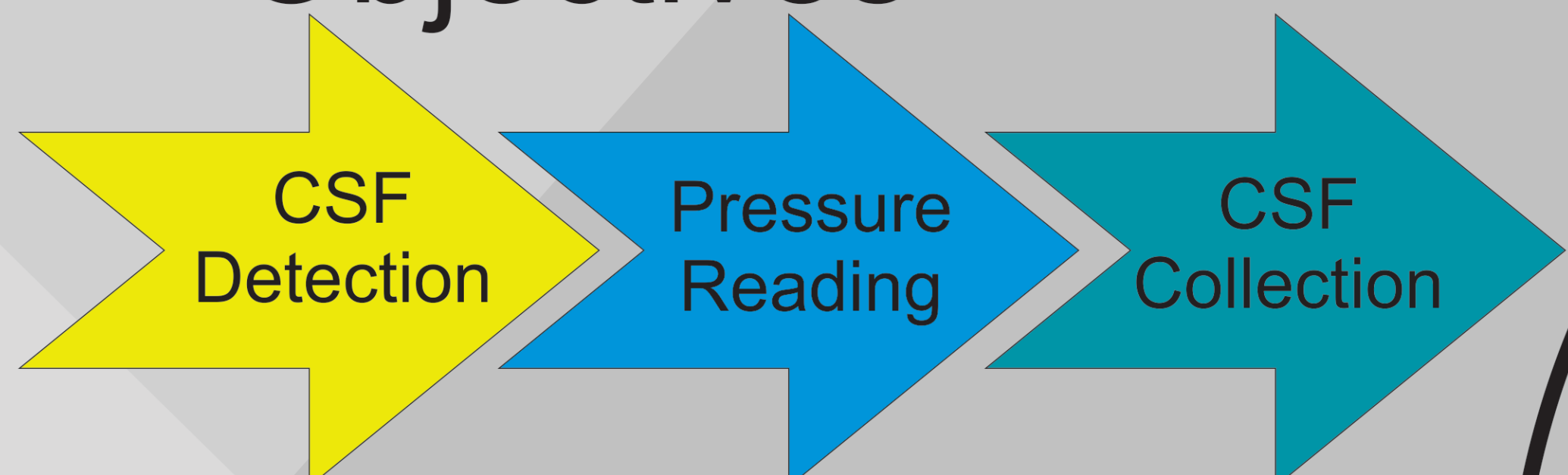
MAYA DAVIDOVIC • RYAN FORD • CARLEY-ROSE HOROWITZ • SANYA PURI



Background

- Lumbar puncture (LP) is a diagnostic tool for neurological conditions including meningitis, Guillain-Barre syndrome and multiple sclerosis
- LP procedure involves collecting cerebrospinal fluid (CSF) and measuring the intracranial pressure of the patient
- Cerebrospinal fluid is in the subarachnoid space and is composed of 99% water
- The opening pressure for a healthy patient is 80-190 mmH₂O (0.8-1.9 kPa)
- Pressures greater than 200 mmH₂O (2 kPa) and less than 80 mmH₂O (0.8 kPa) are considered unhealthy

Objectives



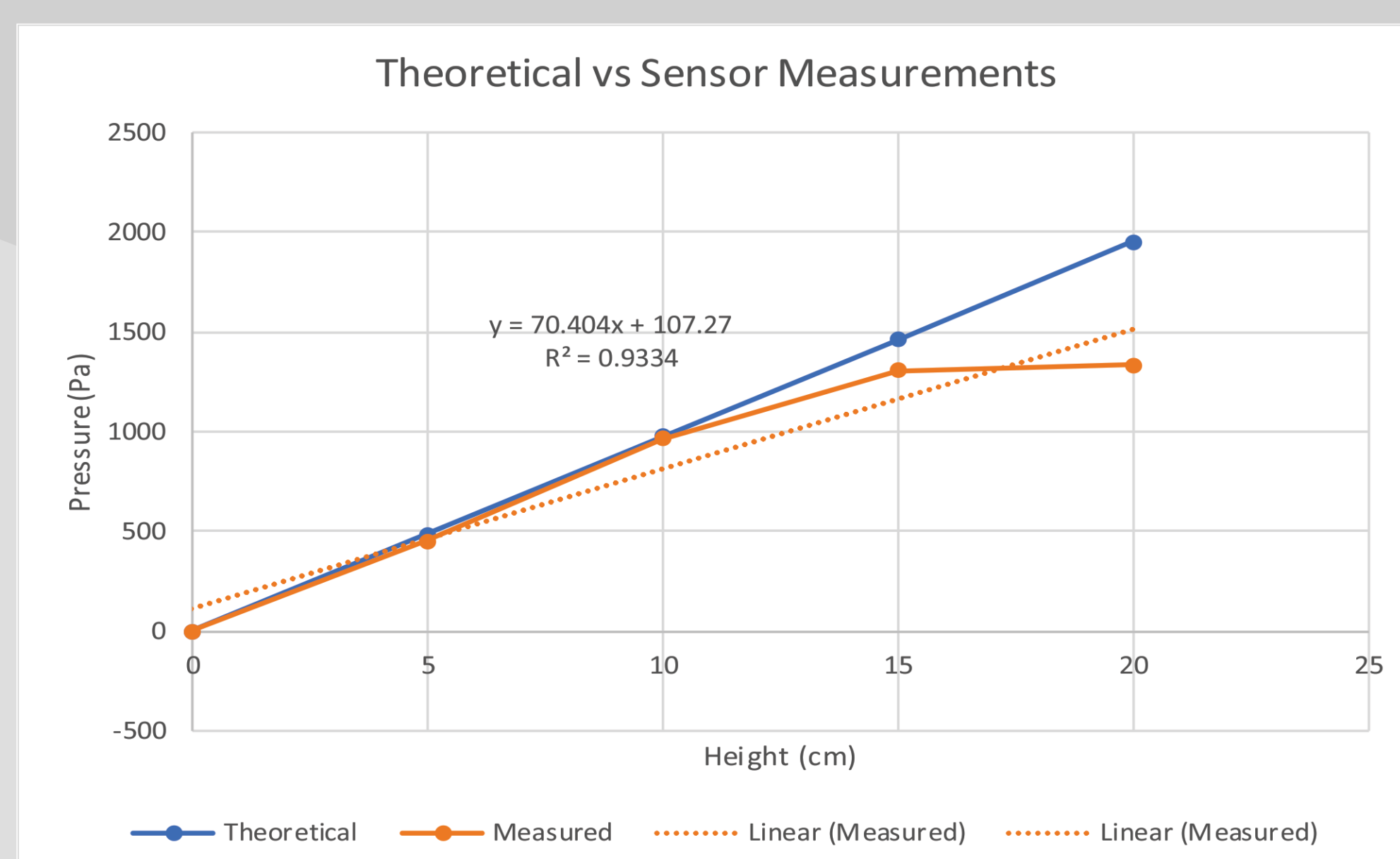
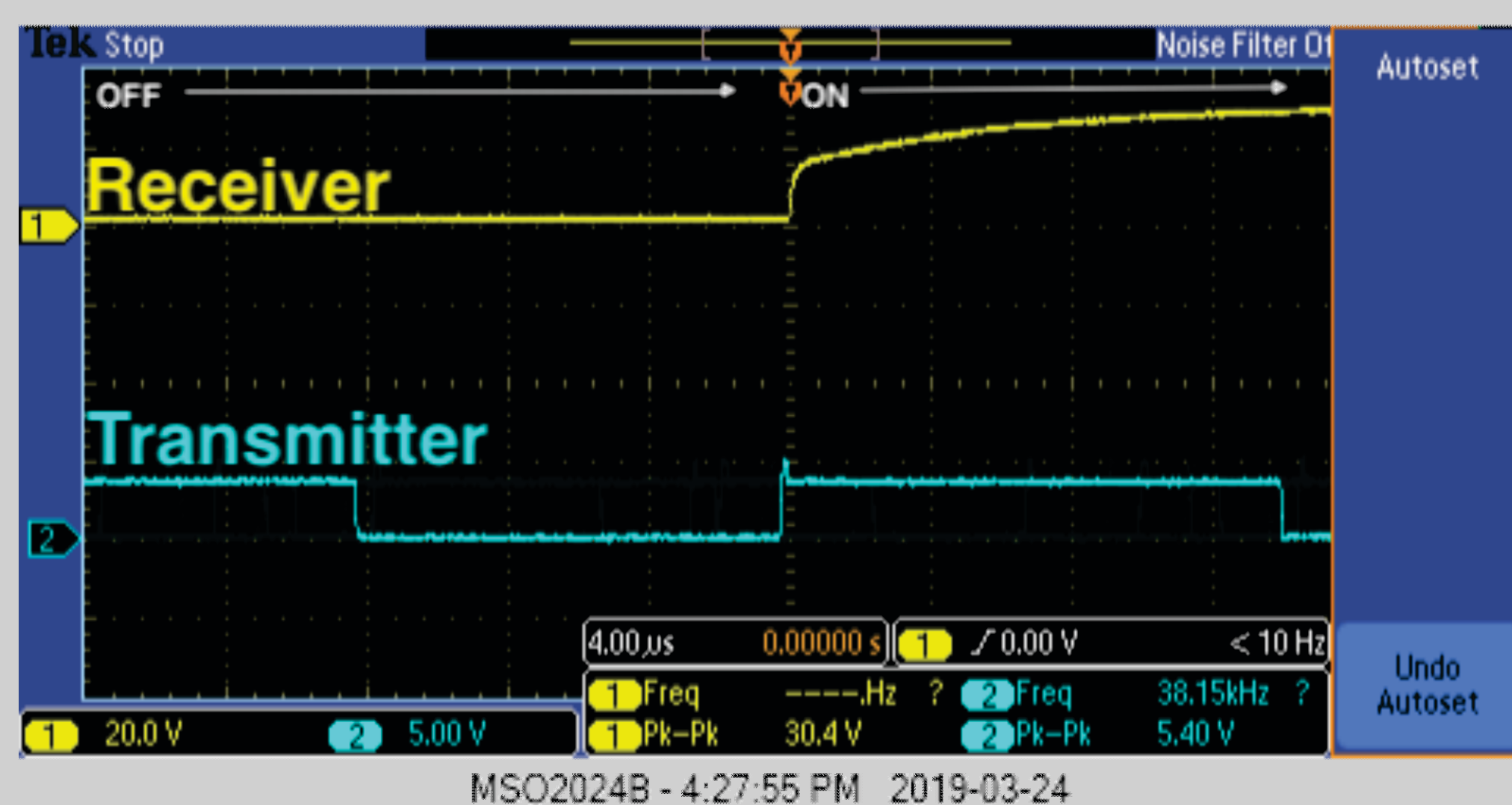
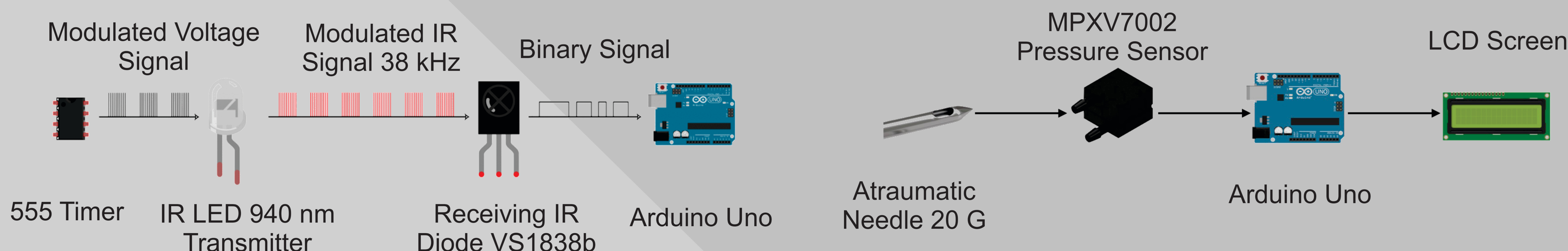
- Create effective detection mechanism to indicate when subarachnoid space has been reached
- Create improved method of detecting intracranial pressure
- Simplify the collection of CSF from the subarachnoid space
- Procedure which requires less time and less people to be completed
- Helps the practitioner ensure that the needle will not surpass the subarachnoid space



Problem Statement



- Low success rate of procedure: 27.6% require 4 or more attempts
- Inefficient procedure: lasts between 30 minutes and 2 hours, patient dependent
- Leads to ER bottlenecks due to timing, large number of people and equipment required
- Manometer readings for intracranial pressure are inaccurate 20% of the time
- Procedure complications arise when performed on infants, obese people, or people with spinal deformities



Design Overview

- Opening pressure is measured by MPXV7002 differential pressure sensor, capable of linear measurements within the desired range of 0 – 2 kPa
- CSF is detected using a VS1838B demodulator receiver and a 940 nm infrared source modulated to pulse at 38 kHz
- Fibre optic wires used to streamline infrared signal towards receiver
- Collection is achieved through the use of PVC tubing connected to a valve and 15 mL plastic vial embedded into the device
- Casing was designed in AutoCAD Inventor and 3D-printed to be ergonomic and compact for physician use
- Ultimately, the proposed design eliminates the tedious components of the lumbar puncture procedure by optimizing the time and accuracy

Future Work

- Optimize needle design by embedding fiber optic in sheath of atraumatic needle to transmit signal into body
- Evaluate the efficacy of the EZ-Tap on Lumbar Puncture Simulator II
- Develop mechanized insertion system to control and monitor insertion/removal and reduce human error

Faculty Advisor: Eranga Ukwatta, Ph.D., P.Eng
Special Thanks: Christopher Collier, Ph.D.