INTRODUCTION
Breast cancer comprised 24.5% of female cases in 2020, with high mortality rates in low/middle economic countries where early detection is difficult [1].

Mammography
- Requires breast compression
- Uses ionizing Radiation
- Need for trained technicians to operate
- Expensive, heavy equipment

vs Microwave Detection
- No breast compression [2]
- Uses non-ionizing radiation
- Cheaper, smaller, portable equipment

Machine Learning
- Microwave signals can be measured and used for imaging and machine learning.
- Allows tumour detection, classification, location, and/or mapping.
- Automatic function desirable for portable devices.
- Transfer learning allows smaller data set sizes

OBJECTIVE: Develop a learning network to detect and locate rods from signal data

METHODS

Forward Projections
- Propagation Time (tt)
- Reflectivity of Medium (tt(τ))
- Multi-Scatter
- Antenna (a)
- Rods (r)
- X 128 Frequencies (0.7 – 3 GHz)
- X 26 Antenna Positions

Data Augmentation
- For each integer n in the range [1,25]:
  1) Rod model rotated ~13n°
  2) Sinogram shifted n columns to the left.
- 25 Data Augmentations per Unique Projection

Data Set
- Sinogram Input, Rod Model Output
- Total Data Set Size of 195 000
- Uniquely Generated Models:
  2500 Single Rod / 2500 Dual-Rod / 2500 Tri-Rod
- Training/Testing Split: 70/30

Network
- Input
- Convolution x 5
- Flatten
- Dense x 2
- Reshape
- Transfer Learning
  - Freeze layers prior to Reshape
  - Retrain remaining layers using real sinogram data from device

Training Parameters
- Loss Functions (calculates accuracy of predictions):
  - Binary Cross-Entropy (BCE), Mean Squared Error (MSE)
- Optimizers (changes network based on loss function):
  - ADAM, Stochastic Gradient Descent (SGD)

RESULTS

Model Predictions
- BCE Predicted Location
- MSE Predicted Location

Model Predictions (BCE/ADAM)
- Image Accuracy Test (BCE/ADAM)

Conclusion
A learning network has been created for rod detection and location. The network was good for detecting different rod model, but struggled to locate single-rod models. In the future, a better representation of single-rod models can be used in the data set to reduce this issue. Transfer learning will later be used on the network with a small data set of real sinogram data.

References