

Distance Preserving Machine Learning for Uncertainty Aware Accelerator Capacitance Predictions



Steven Goldenberg, Malachi Schram, Kishansingh Rajput, Thomas Britton, Chris Pappas, Majdi Radaideh, Jared Walden, Dan Lu, Sarah Cousineau

RESEARCH DESCRIPTION

- Capacitors in High-Voltage Converter Modulators (HVCMs) degrade over time which causes significant downtime
- Extensive simulation data based on available non-invasive sensor data is available
- Modeling HVCM capacitance values with Uncertainty Quantification is necessary to provide a reliable early indicator of failure

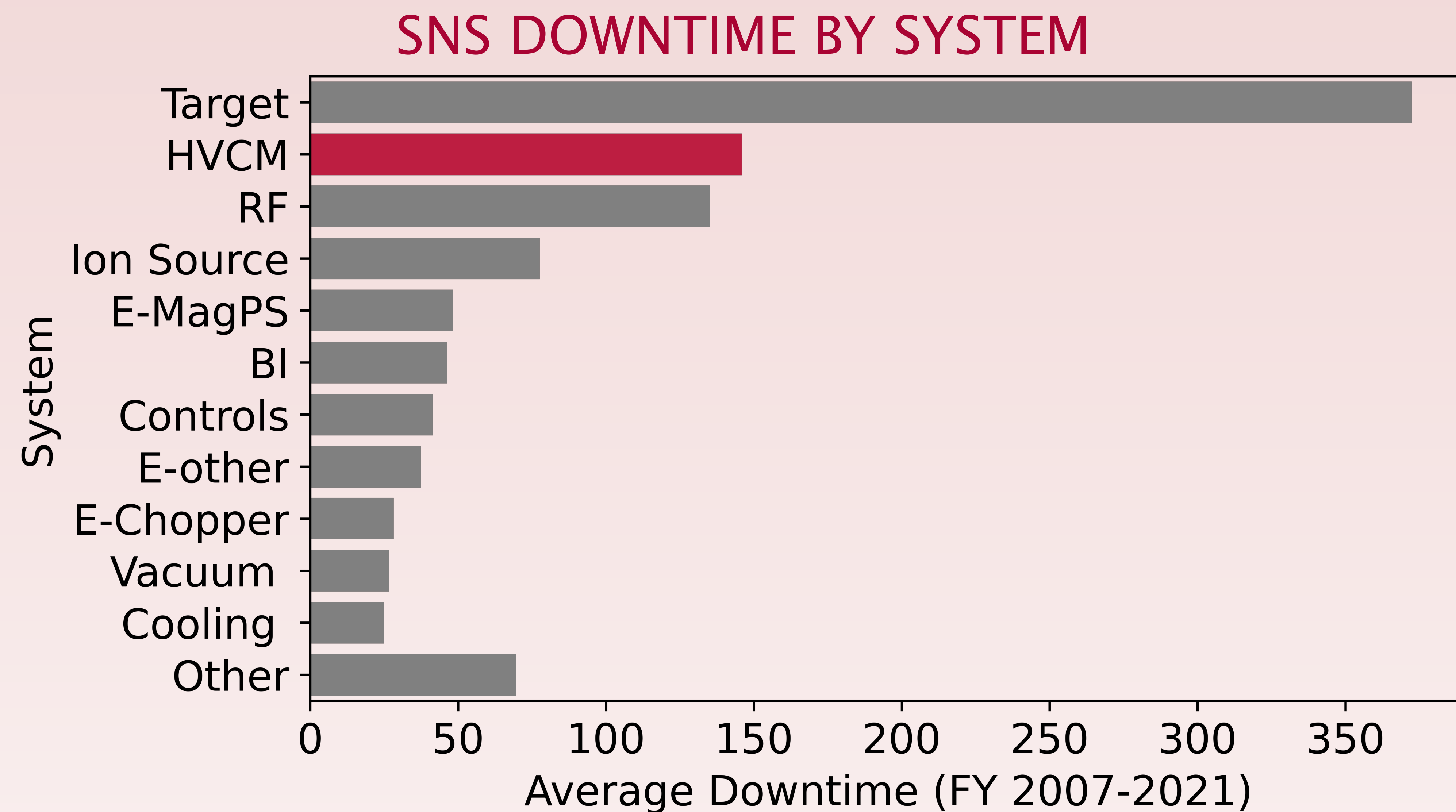


Figure 1: Average downtime by system in the Spallation Neutron Source (SNS) at the Oak Ridge National Lab.

MODEL PERFORMANCE

- <1% in-distribution error
- <3.5% out-of-distribution error
- Increased model uncertainty for out-of-distribution samples

MODEL PREDICTION ERRORS

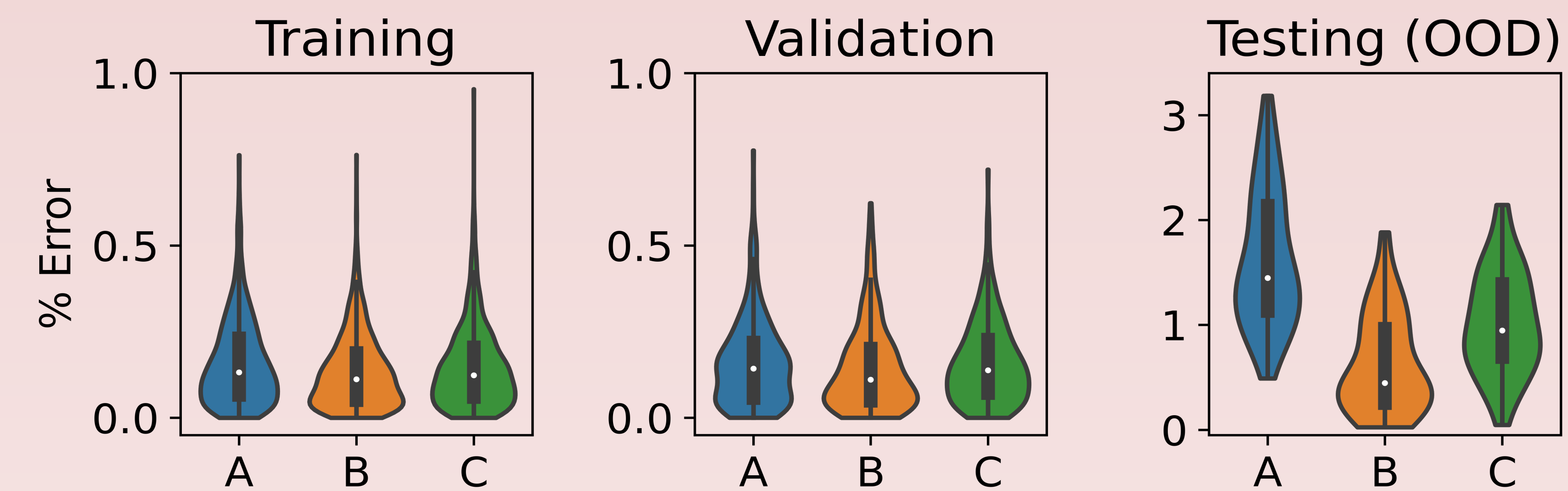


Figure 4: Violin plots of percent errors for each capacitor (A, B, C) over each of our data splits. The width of each plot denotes the density of predictions at that error level.

UNCERTAINTY FROM INPUT NOISE

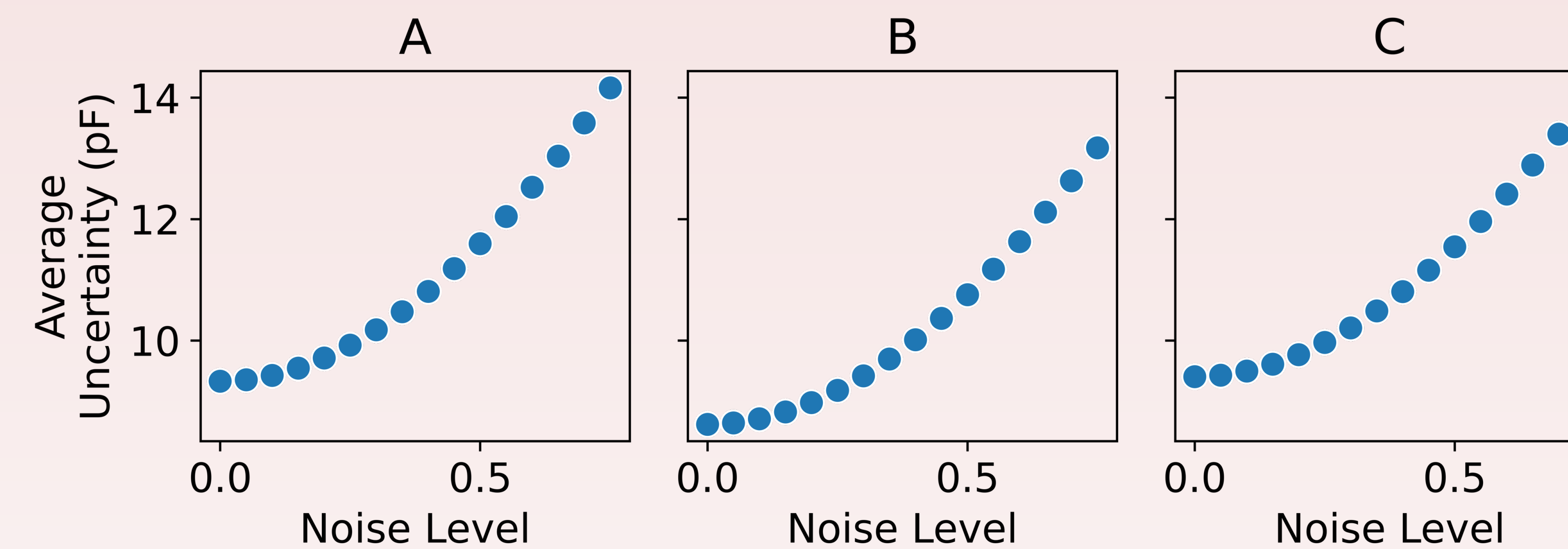


Figure 6: Average uncertainty returned by our model with increasing Gaussian noise applied to the training data.

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