Predicting Avalanches in Granular Materials, PSED Cluster 2017-2018

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Academic Disciplines:
**MATERIALS SCIENCE AND ENGINEERING**
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RESEARCH OBJECTIVE

Apply the methods of machine learning via neural networks to a model chaotic avalanching system to predict the onset of avalanches. Collective behavior is common in many material systems, examples include phase changes and critical phenomena. However, analyzing this behavior is difficult in chaotic systems due to unpredictability and irregularity in their occurrence. Neural networks offer an opportunity to investigate these phenomena in a model system by using learned spatial correlations in granular structure to predict avalanches.
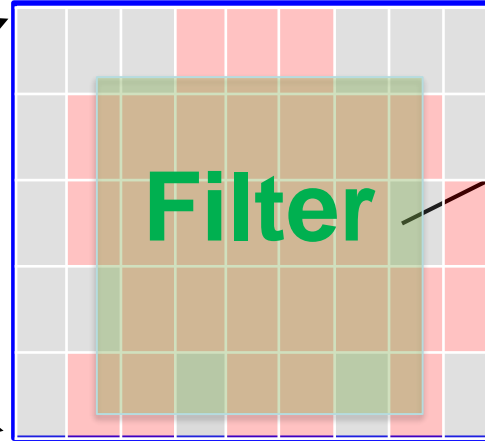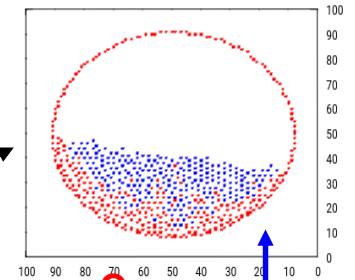
Model System
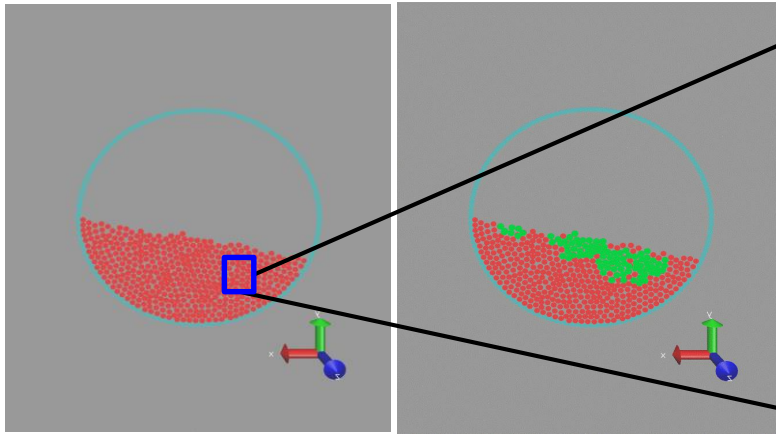
- Slowly Rotating Drum, pre-avalanche

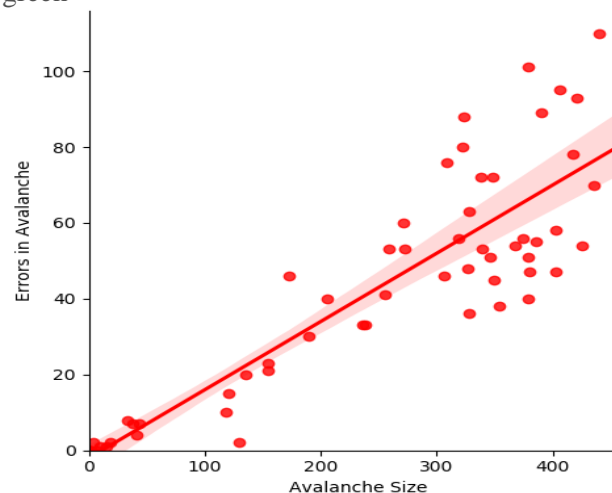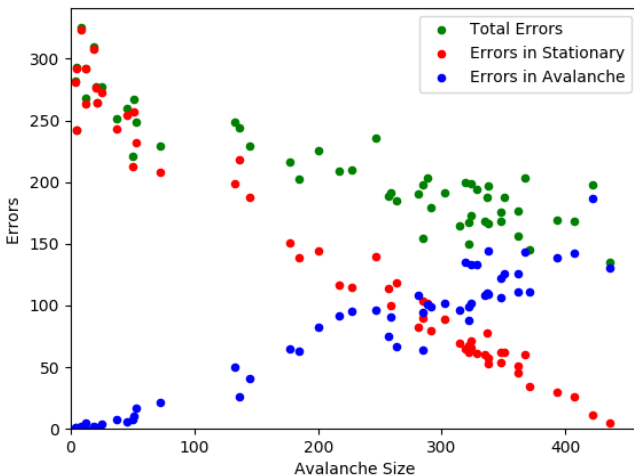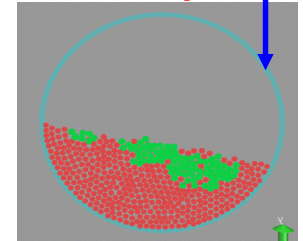- Slowly Rotating Drum, avalanche shown in green

Network Input

Filter

Prediction

Compare

Total Errors
Errors in Stationary
Errors in Avalanche

- Neural Network composed of 4 convolutional filters of size 9x9 predicts avalanches spanning many filter lengths
- Networks predicts avalanches that will happen from only spatial information of system prior to avalanche
- Successfully predicts chaotic events to 85% accuracy