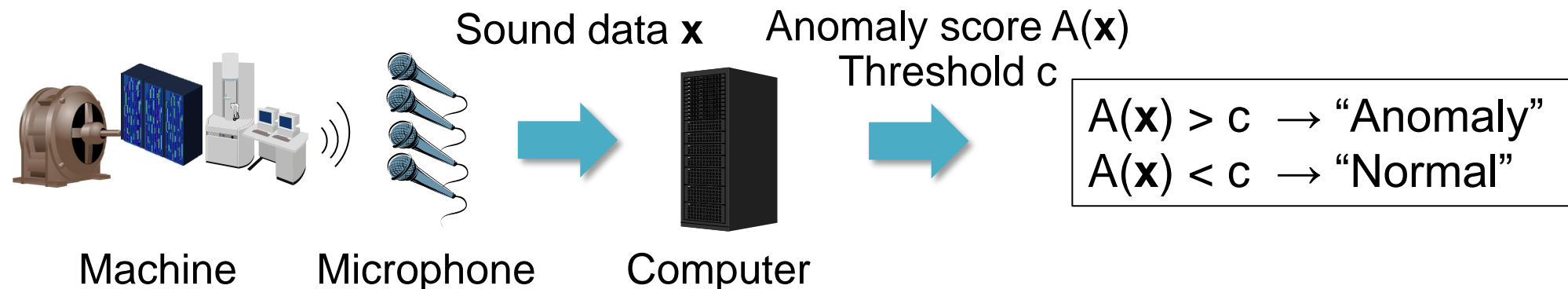# MIMII DG: Sound Dataset for Malfunctioning Industrial Machine Investigation and Inspection for Domain Generalization Task

Kota Dohi, Tomoya Nishida, Harsh Purohit, Ryo Tanabe, Takashi Endo, Masaaki Yamamoto, Yuki Nikaido, Yohei Kawaguchi

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Sound-based maintenance is contactless and low-cost

- Sound-based automatic maintenance using microphones is a low-cost and contactless solution
- Anomalous Sound Detection (ASD) system is used to detect anomalies

Anomalous Sound Detection (ASD) system

Sound data $\mathbf{x}$ Anomaly score A($\mathbf{x}$)

Threshold c

$$A(\mathbf{x}) > c \rightarrow \text{"Anomaly"}$$
$$A(\mathbf{x}) < c \rightarrow \text{"Normal"}$$

Machine   Microphone   Computer

Performance degradation caused by domain shifts

- Domain shifts: Changes in operational states or environmental conditions
- Domain shifts can degrade the detection performance
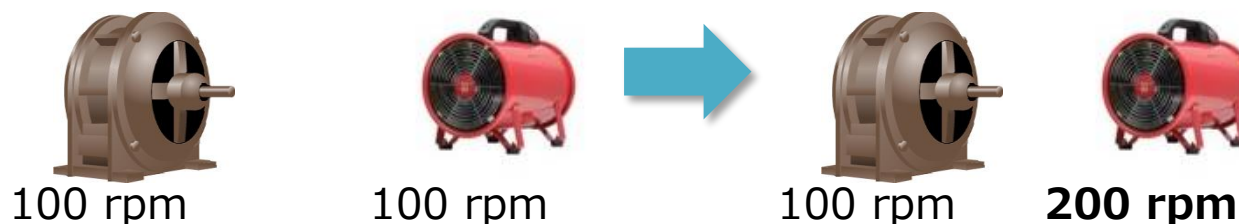
Changes in operational states of a machine

Rotation speed 100 rpm → **200 rpm**
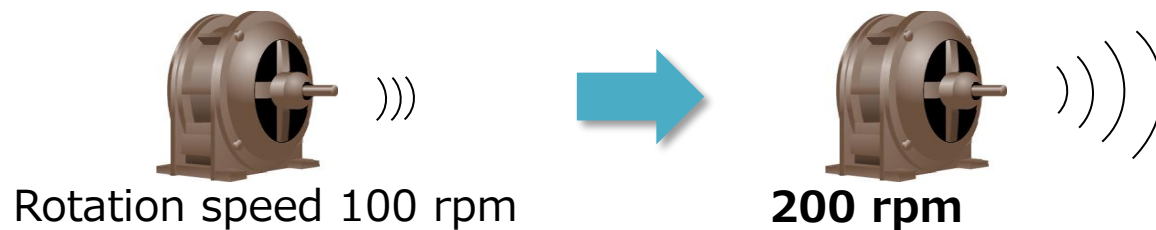
- Changes in rotation speed can cause domain shifts

Changes in environmental conditions
Target Machine   Others

100 rpm   100 rpm → 100 rpm   **200 rpm**

- Changes in states of surrounding machines can cause domain shifts

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Adaptation vs generalization

Domain generalization can be better in some cases

- Adaptation: Adapt the model when domain shifts occur
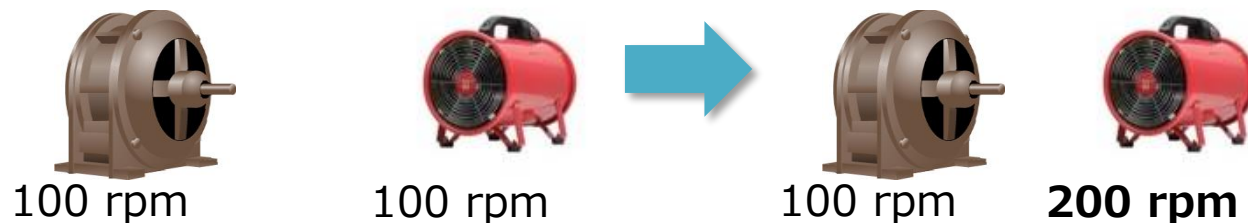- Generalization: Detection with the same model and threshold

If conditions of a machine changes frequently

100 rpm → 200 rpm → 150 rpm ...
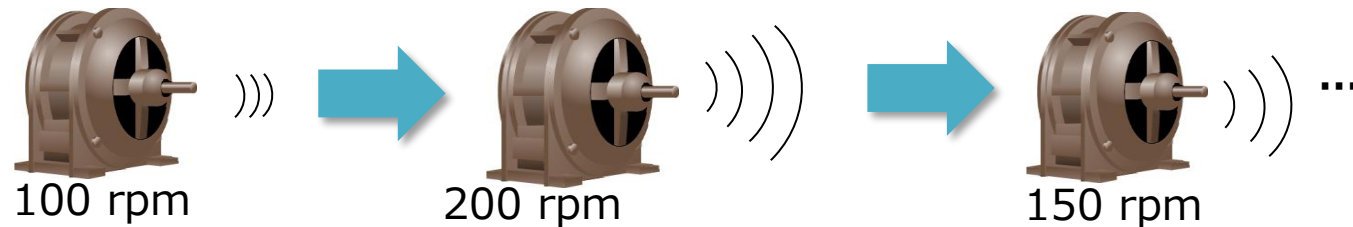
- Not enough samples for adaptation
- Adaptation every time is costly

If domain shifts are hard to notice

Target Machine

100 rpm   100 rpm → 100 rpm   **200 rpm**

- Because shifts are hard to realize, adaptation is also difficult

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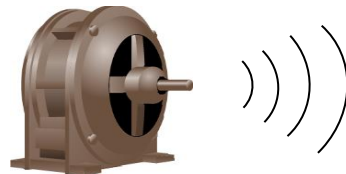## Created a dataset dedicated to domain generalization task

1. Increased parameter sets (at least three sets for each type of shifts)
2. Added hard-to-notice domain shifts (ex. Different pumps in background)

Source domain

Target domain

100 rpm

200 rpm

- Domain generalization using only one parameter set is hard
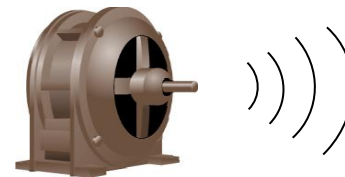
Source domain

Target domain

100 rpm   150 rpm   300 rpm

200 rpm

- Having multiple sets can be useful for generalization

Generalization with multiple sets