# RAMA

## Realtime data Acquisition via Multiscale Analysis

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# The Multiscale Method

**Problem:** Change detection (sudden and gradual changes). Perform the detection of distinct data taking periods on a stream of data from ePIC and other nuclear physics experiments.

Use cases: alarms, autonomous calibration, and autonomous data-quality monitoring

**Our approach:** The development of a new multiscale algorithm to detect changes in a stream of data.

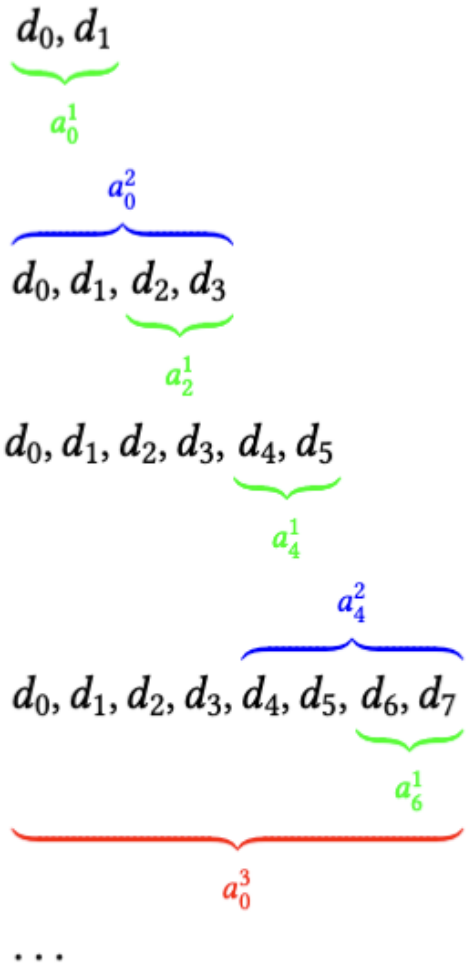
Given a data stream: $d_0, d_1, d_2, \ldots$

We calculate multiscale coefficients:

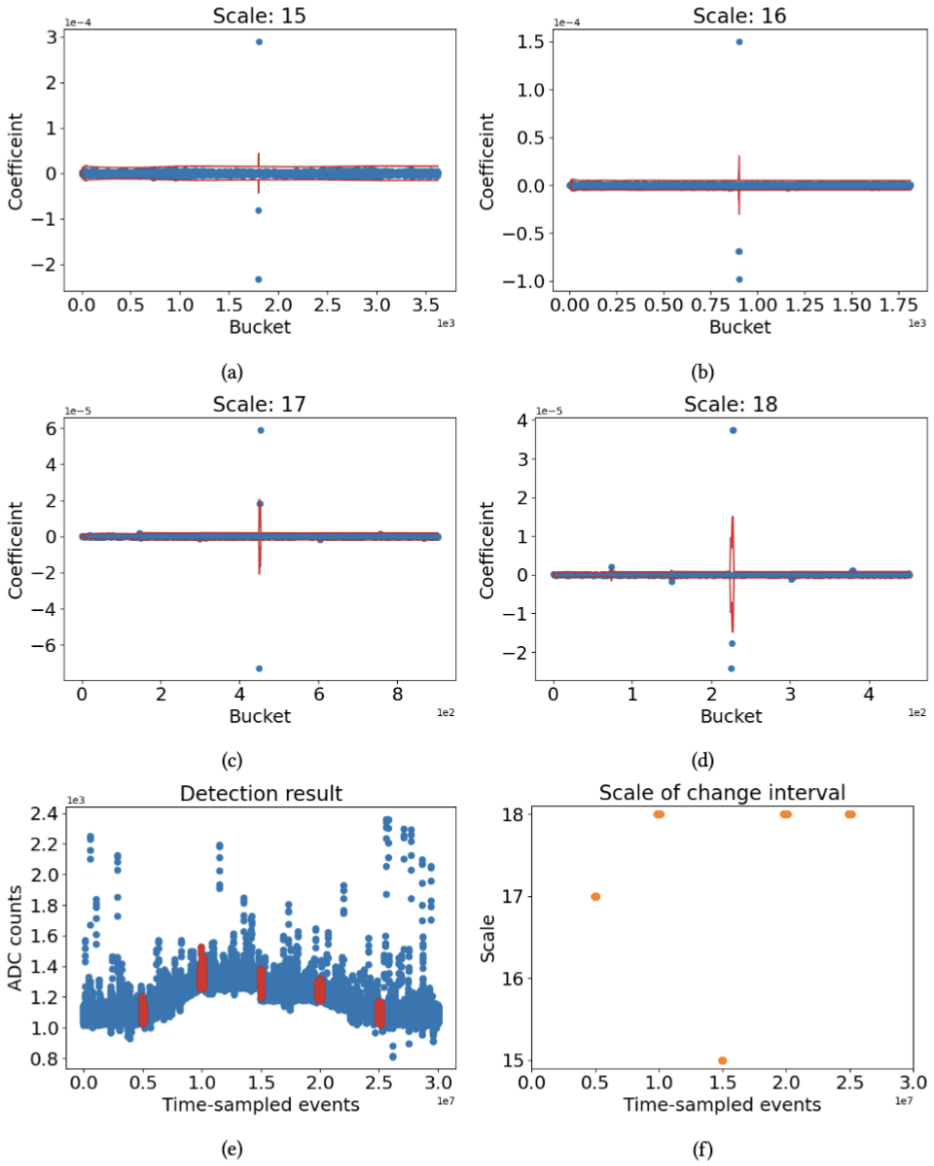
$$a_j^k = \frac{1}{2^{2k}} \sum_{i=0}^{2^k-1} d_{j+i} \phi_k \left( \frac{i + 1/2}{2^{2k}} \right)$$

Where $\phi_k$ is a selected multiscale basis function.

**Method:** Outliers in the multiscale basis coefficient space indicate where changes occur in the stream without any training or assumptions in the underlying data.



Typical results on GEM Detector Data




- We provide a mathematical proof of the smallest scales to detect changes.
- Both the algorithm and the theoretical estimations are verified computationally.
- The online multiscale algorithm has been tested on real detector data, successfully detected peaks, sudden changes, and gradual linear changes.
- Currently, completing the manuscript to submit to a journal.