

## Attachment 1 – DAGSI Research Topic Template

1. **Research Title:** Real-Time Anomaly Detection with Streaming Data
2. **Individual Sponsor:** List the AFRL research topic sponsor's contact information

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3. **Academic Area/Field and Education Level**

Mathematics or Statistics/Pattern of Life – Anomaly Detection (BA/BS, MS or PhD level)

4. **Objectives:** The objective of this research is to develop an innovative approach toward real-time detection of anomalous changes in patterns of life by fusing both hard and soft information sources.
5. **Description:** With the rise of the Internet of Things (IoT) comes the availability of streaming real-time data sources. These sources range from hard information sources such as video to soft information sources such as Twitter. Effective analysis of these streams can result in valuable insight. Real-time anomaly detection of patterns of life has important AF use cases and also is essential in many important civilian applications such as fraud prevention, emergency medicine, and fault detection. Real-time analysis allows for immediate action during critical moments in a diverse set of practical applications, especially in environments where many entities coexist and share complex relationships.

Analysis should be done on data from multiple sources for multiple reasons. Information fusion can reduce uncertainty in multiple singular data sources to create a holistic situational understanding. It also provides contextual information that can reduce false anomaly detections and possibly explain anomalous events.

The researcher will analyze, design, and develop anomaly detection methods for a combination of real-time spatio-temporal social media and sensors data. Programming languages such as Python, R, and MATLAB may be appropriate for doing the statistical work. Necessary methods may include information fusion, statistical models, and machine learning. There are many existing time series anomaly detection frameworks such as Numenta's Hierarchical Temporal Memory (HTM) networks, Yahoo's Extensible Generic Anomaly Detection System (EGADS), and numerous adaptations of an ARIMA model (Ahmad, S. 2016, Amizadeh, S. 2015, & Hasani, Z. 2017).

6. **Research Classification/Restrictions:** Unclassified
7. **Eligible Research Institutions:** DAGSI

**NOTE: Topics submitted to DAGSI must be approved for public release. Need PA Approval #**

PA Approval # 88ABW-2018-3528

References:

Ahmad, Subutai, and Purdy, Scott. "Real-Time Anomaly Detection for Streaming Analytics." *ArXiv*. Cornell University Library. 8 July 2016. [arxiv.org/abs/1607.02480](https://arxiv.org/abs/1607.02480).

Amizadeh, Saeed, Flint, Ian, and Laptev, Nikolay. "Generic and Scalable Framework for Automated Time-series Anomaly Detection." *ACM Digital Library*. Association for Computing Machinery. 10-13 August 2015. <https://dl.acm.org/citation.cfm?id=2788611>.

Hasani, Zirije. "Robust Anomaly Detection Algorithms for Real-Time Big Data: Comparison of Algorithms." *2017 6<sup>th</sup> Mediterranean Conference on Embedded Computing (MECO)*. IEEE. 13 July 2017. <https://ieeexplore-ieee-org.wrs.idm.oclc.org/document/7977130/>.