RY20-12

Attachment 1 – DAGSI Research Topic Template

NOTE: Under the Cooperative Agreement, Technical Directorates have three options for topics. First, a topic can strictly be considered in the pool for the state allocation of funding. DASI will work across the TDs for this allocation. Second, the TD can be prepared to be a funding partner with the State of Ohio. This would include: providing additional funds to support additional recipients of a topic, or expand the proposers team to include additional members on a topic. Third, the TD may elect to fully fund a topic not selected for State of Ohio funding or to pursue University teams outside the State of Ohio. Contact Michael.hitchcock.3@us.af.mil for questions

1. **Research Title:** Provide the proposed research title
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 adaptions 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. 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.

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 6th Mediterranean Conference on Embedded Computing (MECO). IEEE. 13 July 2017. https://ieeexplore-ieee-org.wrs.idm.oclc.org/document/7977130/.