Project Title: Novel Big Data and Artificial Intelligence Analytics Methods for Tracking and Monitoring Maritime Traffics

Project Abstract (Brief Description): This project will utilize Automatic Identification System (AIS) datasets to design scalable Maritime Traffic Monitoring and Analysis (MTMA) applications and tools and work with two Computational data enabled science and engineering (CDS&E) students produce two dissertations in this direction. Critical applications such as the detection of anomalies, offshore and onshore attacks and data intrusions, require fast mechanisms for Artificial Intelligence (AI) analysis of thousands of events per second, as well as efficient techniques for the analysis of massive historical AIS data. There has been major developments of Big Data Analysis Frameworks for analyzing the AIS historical data, but their applications and scalable analysis techniques to the MTMA domain remains poorly understood and difficult to benchmark. This project introduces several novel 2-D points data collection system using AIS data that will aid in monitoring maritime traffic and directly assist in adverting accidents, tracking vessels, and support in avoidance of dangerous environments. Densitybased spatial clustering of Applications (DBSCAN) using pairwise distance matrices, the Haversine distance function and real-time AIS streaming data algorithms are a few of the many techniques we will employ finding core points in relation to a vessel and its outliers. This will show AIS equipped vessels/ objects in an inputted radius to a given Latitude/Longitude coordinate pair and identifies anomalies or what could possibly be other AIS equipped vessels/object with erratic behavior using streaming AIS data. The project also explored a distributed cloud-computing framework based on the Big Data and Artificial Intelligent data analytics approach where both storage and computing resources can be scaled out to collect and process marine vessel traffic from AIS network in a reasonable time.

Describe Implementation of Research Outcomes - The project will engage two CDS&E Ph.D. students with excellent academic records in a yearlong research activity in the use AIS data to model maritime traffic tracking and monitoring. Consequently, there will be two Ph.D. dissertations resulting from the outcomes of the project. The program Graduate Assistants will acquire broad data science and big data analytics skills geared towards effective applications of the CDS&E methods in novel maritime traffic modeling and analysis. There will be three scholarly articles resulting from each objective of the project. The plan is to publish them in peer reviewed Transportation professional journals.

Impacts/Benefits of Implementation - The proposed projects will advance the understating of the MTMA communities on the open problems. The outcomes of the project have direct impact and application in the MTMA domain, including benefits for large shipping line operators and maritime traffic monitoring technology vendors. The techniques developed within the span of the project as well as their applications to AIS and freeware data analytic problems would also be highly beneficial to other domains where similar data analysis problems arise, including the Online monitoring of road traffic devices, the Online extraction of knowledge from big data associated to smart cities scenarios, the processing of the massive data generated by the Internet of Things with trillions of devices connected to the Internet, and many other application domains. Being the Big Data Analyst a fast-growing worldwide market, the development of analysis techniques, technologies will directly benefit the research on MTMA. The state of Mississippi, being a coastal state will benefit from the technologies that will result from the MTMA research and the outcome of the projects we have proposed to carryout.

Web Links: martrec.uark.edu

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