2020 Project Summaries
Boreal Ecosystem Recovery & Assessment
An NSERC Collaborative Research & Development Program

Internet of Things Team: Spatio-temporal Analytics for IoT Observations

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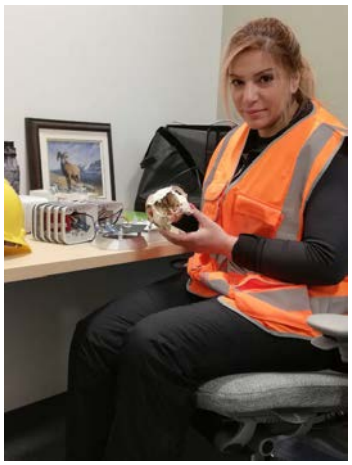

Project Summary

In this project, different Internet of Things (IoT) prototypes were developed using a network of low-cost ground sensors (*e.g.,* temperature, humidity, accelerometer, and motion sensors) to test the hardware units and communication reliability for monitoring human/animal footprint. We focused on the requirements for spatiotemporal pattern mining and finding suitable algorithms for physical condition and human/animal presence. The purpose was to implement and evaluate appropriate spatiotemporal analytics to classify the data, find useful patterns, and detect anomalies. We evaluated two applications: 1) Similarity analysis between humidity and temperature time-series of different sensors by applying the Dynamic Time Warping algorithm; and 2) Automatic human motion detection (e.g., walking, biking, or driving) using the accelerometer signal (i.e., Signal variance, spectral energy and entropy). The classification was realized by the Bayesian Network (BN). BN is a probabilistic graphical model that encodes probabilistic dependencies among the corresponding variables of interest by using the training dataset. Thanks to the open geospatial IoT standard, the development of spatio-temporal analytics is faster and easier. We used microclimate analytics to build machine-learning procedures using the real-time IoT data streams after deploying the sensor on a large-scale basis in the field.

Management Implications and Lessons Learned

Establishing an interactive IoT system to include field data collection, essential analytics and visualization in one common operational picture is an important tool in making informed decisions for managers, analysts, stakeholders, and public policymakers. The IoT platform provides online access to the physical condition of the boreal ecosystem at any time and anywhere which is a solution for management implications. This information can be used in an active management system to visualize various sensor data on a map, compare them from different locations (seismic lines or deep forest areas), detect similar time-series patterns using machine-learning techniques, plan different scenarios and provide relevant analytics to maintain forest recovery and health.