Innovative Solutions Canada

CHALLENGE NAME: ARTIFICAL INTELLIGENCE AND BIG DATA ANALYTICS FOR ADVANCED AUTONOMOUS SPACE SYSTEMS

SUMMARY: The challenge is to apply artificial intelligence and big data analytics to bring tangible advancements in the operation and utilization of space assets in support of government operations, public safety, public health and discovery.

CHALLENGE NUMBER: *To be determined*

CHALLENGE CLOSING DATE AND TIME: *To be determined*

CHALLENGE SPONSOR: Canadian Space Agency

MAXIMUM CONTRACT VALUE:

Multiple contracts can result from this Challenge.

The maximum funding available for any Phase 1 Contract resulting from this Challenge is $150,000.00 CAD (plus tax) including shipping, travel and living expenses, as applicable.

The maximum funding available for any Phase 2 Contract resulting from this Challenge is $1,000,000.00 CAD (plus tax) including shipping, travel and living expenses, as applicable. Only eligible businesses that have completed Phase 1 could be considered for Phase 2.

This disclosure is made in good faith and does not commit Canada to contract for the total approximate funding.

TRAVEL: For Phase 1, it is anticipated that three meetings may require the successful bidder(s) to travel to the location identified below:

MEETINGS	LOCATION
Kick-off meeting	CSA, St-Hubert, Québec
Progress Review Meeting	Teleconference/videoconference
Final Review Meeting	CSA, St-Hubert, Québec

PROBLEM STATEMENT

While space operations environments, including those in Government of Canada, continue to incrementally automate data processing and analysis pipelines, this automation tends to be focused within missions. There has been little advancement in merging large and diffuse datasets, despite the ongoing growth of open data archives across the globe. Such datasets are no doubt complementary but new methods – leveraging recent advancements in artificial intelligence and big data analytics - are needed to take advantage of and draw new meaning from the data from multiple space, airborne and ground platforms.

Benefits of such large-scale analysis include:

- Improved coordination and efficiency of planning of spacecraft tasking;
- Improved identification of anomalies, hazards or performance degradation over time;
- Innovative autonomous detection and learning of subtle phenomenon not easily observed or expected by studying data in isolation.

The challenge is to apply artificial intelligence and big data analytics to bring tangible advancements in the operation and utilization of space assets in support of government operations, public safety, public health and discovery. Mining of long-term telemetry archives can lead to enhanced operations of space assets. In space exploration, recombination of data from a variety of sensors observing space and other celestial bodies could lead to new discoveries and new lines of inquiry into the universe. Terrestrially, these methods could enable autonomous prediction of natural or man-made disasters and lead to transition from reactionary imaging in response to crises to new services in predicting and preventing disasters (including fires, floods, disease outbreak, space weather events, etc.).

DESIRED OUTCOMES & CONSIDERATIONS

The potential benefits of applying artificial intelligence and big data analytics to large and heterogeneous space data sets include:

- Improved coordination and efficiency in task planning, for example, to minimize redundancy between disparate missions imaging the same targets (which can even cause interference in the case of active sensing);
- Improved identification of and recovery from anomalies, hazards or performance degradation by discovering new information in mission telemetry. Such discovery could lead to new techniques/calibration and to maintain/improve performance and extend mission duration. In the case of the International Space Station (ISS), this could include taking advantage of its many cameras to draw knowledge on the state of the ISS structure over time and/or insights into the surrounding environment and potential shielding strategies;
- Learning subtle new phenomenon to enable autonomous prediction of natural or man-made disasters, which could allow Earth observation platforms to transition from reactionary imaging in response to crises to new services in predicting and preventing disasters, (including fires, floods, disease outbreak, space weather events, etc.);
- Enhancing space exploration by combining data and applying relevant new techniques to the datasets from the variety of telescopes and sensors looking into space, or observing other celestial bodies, to contribute to new discoveries and an improved understanding of processes relevant to space exploration or astronomy;
- Other discoveries not envisioned above, but enabled by applying new techniques to the wealth and depth of available space-based data.

BACKGROUND & CONTEXT

Space platforms are becoming increasingly popular, with several private companies announcing new satellite constellations/platforms to provide a multitude of services on Earth and far beyond. With lower cost, higher productivity and increasing autonomy of such space assets, the space operations community will soon be dealing with a multitude of missions becoming operational and an exponential increase in the amount of data available to be processed, analyzed and turned into operational products.
Beyond the large telemetry archives typically available within space operations data centres, commonly accessible archives of potentially relevant data include:

- Government of Canada Open Data Portal;
- National Earth Observation Data Framework Catalogue (NEODF);
- NASA Open Data Portal;
- Canadian Astronomy Data Centre (CADC);
- Minor Planet Centre;
- USGS Landsat Global Archive;
- Copernicus Open Access Hub.

It is believed that new methods based on recent advancements in artificial intelligence and big data analytics can be applied to directly support the Canadian Space Agency in managing its space asset fleet and yield far-reaching potential in improving public safety, public health and discovery.

This initiative is aligned with the Government of Canada's Open Data Policy, which is challenging for space data, given data policy factors such as security and commercial sensitivity for some subsets of the data. Segregating the data to ensure compliance with all applicable data policy factors would also need to be addressed as part of the work.

ACQUISITION STRATEGY

It is anticipated that a CFP will be posted on the Buy and Sell website in January 2018. The CFP will describe the proposal submission instructions and the evaluation procedures and criteria against which proposals will be assessed.