Plan Overview

A Data Management Plan created using DMPonline

Title: FinTech/RegTech in Space for Trustful Autonomous Robotic Interaction

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Project abstract:

With the recent growth in space business, we can expect a number of companies to join space agencies not only in space transport but also in space resource exploration and exploitation. Resource exploration means gathering information in very limited time: Every minute and every single square meter analysed on the surface of a celestial body might represent an important part of the full cost of the mission and the estimated revenues. At the same time, there are good reasons that missions will involve multiple robots operating simultaneously in the same area, possibly owned by different companies. As in space unexpected can happen frequently, planning ahead cooperation between these robots is not always possible. Instead, robots will need to make autonomous decisions on cooperation, thereby following the economic rationale of their owner company. E.g., robots could rely on other robot’s telecommunication infrastructure when transferring large amounts of data.

Companies could even install robots that do nothing but provide infrastructure such as telecommunications to earth. Robots need to be able to decide autonomously and dynamically, when to use such a service and what price to pay. In the FiReSpARX project we would like to explore the potential of Distributed Ledger Technologies (DLT) to enable governance and trust between robots in space. Through Intelligent Agent Technologies (IAT) we would like to enable robots to represent the economic rationale of their owner, bargain conditions of a deal, and trustfully document the result. In comparison to existing multi-robot systems, we will need to build a new multi-robot system architecture capable of integrating DLT. Put together, we could create a research prototype featuring smart, secure, and trustful interaction within multi-robot systems.

Our LunaLab, a lunar analogue facility, provides for an almost unique environment to test and validate our prototype. From the FiReSpARX project we expect academic impact in terms of contributions to knowledge especially on space robotics and on distributed ledger technologies. In terms of long-term economic impact, our project outcomes will be analysed into detail for potential extensions to increase our technology readiness level, funded e.g.

through the European Space Agency (ESA) or industry. If successful, our system could lower market barriers in the space sector and thus transform the whole industry.

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Copyright information:

FinTech/RegTech in Space for Trustful Autonomous Robotic Interaction

Data Collection

What data will you collect or create?

We will create maps and sensing data of the Lunalab of the University of Luxembourg and a quarry, including information on topography, geological, and environmental conditions. Additionally, we will gather transaction data created and stored on a test blockchain, capturing information related to the transactions executed on it.

In terms of data format, we will use open and widely accepted data formats, such as CSV, JSON, or XML, to ensure that the data can be easily shared and accessed. We will store the data in secure and reliable storage systems such as data repositories or cloud storage and create regular backup copies to prevent data loss. Any existing data or third-party sources we use will be cited and appropriately acknowledged in our research output.

Finally, we will also consider if there are any existing data that we can reuse. We will look for open and freely available data repositories or sources that can provide relevant data to complement our research, thus avoiding unnecessary duplication of effort and resources.

How will the data be collected or created?

To ensure that the data is collected accurately and consistently, we will use RGBD cameras, LIDAR, and similar sensors, well-established data collection tools in cartography and remote sensing. These sensors will be operated following established community data standards and methodologies.

We will adopt appropriate naming conventions, version control, and folder structures during the project to ensure the data is organized and easily accessible. For example, we may include information such as the position, date, and sensor type in the file names to enable easy identification and sorting of the data. Version control will ensure that changes made to the data are documented, and older versions are preserved for future reference.

To ensure the consistency and quality of data collection, we will adopt appropriate quality assurance processes. These may include calibration of sensors, repeat samples or measurements, standardized data capture or recording, data entry validation, peer review of data, or representation with controlled vocabularies. This will help us to ensure that the data is reliable, accurate, and suitable for the intended use.

Documentation and Metadata

What documentation and metadata will accompany the data?

We will include basic information about the data, such as the title, author, date of creation, and license information, which will help people to find and access the data, given that it is already being

shared in open-source versioning control systems. We will also provide a clear and concise description of the data, including the methodology used, analytical and procedural information, variables definitions, vocabularies, measurement units, and any assumptions made during data collection and analysis, given the focus is to publish thus, guaranteeing the reproducibility.

In addition to the metadata records, we will provide detailed documentation for each dataset, explaining the data's context, how it was collected, and how it can be used. The documentation will be available in the form of a data management plan or a readme file and stored alongside the data.

Finally, we will ensure that any publications or research outputs that use the data cite the appropriate data sources so that others can trace the data's origin and access the original data if necessary. This will ensure that the data is properly credited and acknowledged and will help to promote data reuse and sharing.

Ethics and Legal Compliance

How will you manage any ethical issues?

We do not expect to face any ethical issues as we are working with a simulated environment of Lunalab for controlled robotic interactions. We will take several steps to manage any ethical issues that may arise. Firstly, we will ensure compliance with relevant data protection laws and regulations, including obtaining any necessary permissions or licenses for data reuse.

We will also be mindful of the sensitivity of any data involved in the project, particularly about national security or critical infrastructure. Appropriate security measures will be implemented to protect this data from unauthorized access or use. Also, we will ensure that any existing data being reused was collected ethically and responsibly and that all necessary permissions were obtained for reuse.

How will you manage copyright and Intellectual Property Rights (IPR) issues?

The data will be restricted until publishing. However, the ownership and licensing of the data will be determined by the institution and the project's principal investigator (PI). The data managers and researchers involved in the project will also have access to the data for analysis and research. Interested scholars and other relevant parties may request access to the data. The PI and the institution will determine their permission level according to any relevant policies or agreements. Copyright and IPR issues will also be managed following the institution's policies and guidelines and any relevant funding bodies.

Storage and Backup

How will the data be stored and backed up during the research?

The data will be stored on the laptop and the onedrive service of the university.

How will you manage access and security?

The data are not confidential.

Selection and Preservation

Which data are of long-term value and should be retained, shared, and/or preserved?

The data will be held and kept as long as the project is running. It will also be available in public repositories for as long as they exists

What is the long-term preservation plan for the dataset?

To be determined, all means will be used to ensure the data used and created for the project remains available.

Data Sharing

How will you share the data?

The data with acknowledged long-term value will be shared by storing them in public repositories, which will be referenced in the publications. The data will be available to potential users who can find it easily. The conditions for sharing the data will be outlined and adhered to. The PI and the data management team will consider the most appropriate data-sharing mechanism, considering data type, size, complexity, and sensitivity. The data will be made available as soon as possible after publication, and a persistent identifier will be pursued to ensure long-term access to the data. Acknowledgments for data reuse will be included to provide proper attribution to the original data creators.

Are any restrictions on data sharing required?

At first sight, no, there are no restrictions on data sharing required. All data collected will be available for sharing as soon as it is processed and analyzed. We believe in the importance of open science and making our research available to the broader community.

Responsibilities and Resources

Who will be responsible for data management?

The Data Management responsibilities are assigned to the Post-docs, whereas the PI is responsible for successfully managing the project with support from the Ph.D. students. Loïck Chovet, given his computer science expertise, is handling the DMP. The Ph.D. students and Post-docs are responsible for data capture, metadata production, data quality, storage and backup, and data archiving. The PI and Post-docs will assist in data sharing.

What resources will you require to deliver your plan?

Yet to be determined, but it is highly suggested that we will require access to a high-performance computing cluster, specialized simulation, and data analysis software. Additionally, depending on the project's development, we may need to purchase specific hardware components, such as scientific sensors and hardware. We may also need to budget for any charges applied by data repositories where we might deposit and share the data.