MASTER

Multiple ASpects TrajEctoRy management and analysis

Inside this issue

Editorial

We now entered the second year of the project and we have many news, secondments and research results to share with you!

We are very happy that our EC Project Adviser Simona Losmanova from REA accepted to answer some of our questions and curiosities about the tasks and issues that a RISE project adviser has to cope with. Mrs Losmanova kindly reported her experience and gave suggestions to MASTER consortium and RISE projects in general on how to succeed!

We have now completed more than 37 secondment months of staff to non academic and to/from international institutions, with 16 researchers involved: 6 of them are female and 10 are male. We report on the secondments executed so far presented by hosting institutions. We also have asked secondee to fill in an interview reporting their experience, and here we report some highlights.

We are also very proud of the research results that we have published in scientific papers. At the moment we count 21 papers published by project partners with the MASTER ack, all available for download at the project web site: http://www.master-project-h2020.eu/documents-and-publications/

We have selected two very recent papers linked to WP3, namely how to construct, model and manage multiple aspect trajectories. Specifically, how to define and model multiple aspects trajectories is the objective of the paper "MASTER: a multiple aspect view on trajectories", jointly developed by Federal University of Santa Catarina (Brazil) and CNR (Italy) presenting a conceptual model and an RDF schema for multiple aspects trajectories. This paper has been recently accepted in the journal Transactions in GIS and will be published soon. A second contribution is the paper "VISTA: A visual analytics platform for semantic annotation of trajectories" by Dalhousie University (Canada) and CNR (Italy) presented at the 22nd International Conference on Extended Data Base Technology, Lisbon, 26-29 March, 2019 presenting a system for semantic annotation of trajectories.

MASTER partners are also supporting the organization of two workshops in project related topics: The Second Workshop on Big Mobility Data Analysis, held in Lisbon in conjunction to Extended Database Technology conference on March 26th (http://bmda19.datastories.org) and the First Workshop on Fairness, Accountability, Transparency, Ethics, and Society on the Web (http://fates19.isti.cnr.it), to be held in conjunction to The Web Conference in San Francisco next May 14th, 2019.

You can download this and previous issues of the newsletter from the MASTER web site:
http://www.master-project-h2020.eu

The next issue will be published at the beginning of September 2019, reporting more secondments experiences, research results and events.

Stay tuned and happy reading!

Chiara Renso, Project Coordinator

The MASTER Coach

An interview with Simona Losmanová

Chiara Renso, Project Coordinator, HPC Lab, ISTI-CNR, Italy

At the RISE Coordinator's Day held in Brussels last January 2018 the RISE project officers has been defined as "coaches" or "guardian angels" supporting the project coordinators and their consortiums. We liked this definition... because it is true! In this first year of project im-

to international and/or non-academic institutions to boost the carrier of researchers. This idea of secondment as a long stay in a different research environment developing collaborative research differentiates them from others most known programmes funded by H2020.

researchers, to the evaluation of the research results.

The Consortium has some questions and curiosities about the activity of a "coach" of RISE projects, and MASTER in particular. The MASTER project officer

From left to right we see Chiara Renso (CNR), Francesca Borri (CNR) and Simona Losmanova (REA) during Coordinator's day, January 18,19 2018

plementation we realized that a "RISE coach" has to cope with several very different issues, not only advising about the administrative duties and regulations. In fact, RISE are very specific funding scheme from the Marie Slodowska-Curie actions programme based on the principle of "secondment" of staff

As involving the mobility and carrier perspective of researchers, the issues and problems to be solved through the project lifetime are very different compare to other funding schemes: from secondment replanning, to refocussing research objectives, the support for the carrier developments of the seconded

Simona Losmanova kindly accepted to answer our questions as reported in the following interview.

Q.: Which are the most challenging tasks in "coaching" RISE projects?

A.: It is important to share with new pro-

ject consortia the expectations that European Commission has towards management of EU funded grants. There are many procedures and obligations to be respected, for example communication between granting authority and consortium or a continuous delivery of project outcomes in timely manner and quality standard. As project "coaches" we help consortia to be aware of processes and follow requirements in order to successfully implement and achieve the expected level of results. Despite many simplifications implemented by the EC since the launch of the funding programmes, it may still seem that the EC has high demands compared to other schemes but it is our joint interest to make sure that the tax payers' money is well invested and the project delivers what has been agreed.

Q.: What are the most common mistakes you see throughout the project implementations?

A.: Most beneficiaries do really great job. One thing that could be improved is timely communication about changes to the project plan. Then there could be small things like missing project reference in email communication between consortium and the EC. We are also continuously checking proper acknowledgement of EU funding in all project outcomes so I would suggest applying the standard acknowledgment as mentioned in your grant agreement.

Q.: Which suggestions can you give to the MASTER partners and in general to a RISE consortium, for a successful project? Or, in other words, to which aspect should we pay more attention in running our activities?

A.: My personal advice for each involved researcher is to allocate sufficient time to reading of guidance documents such as RISE relevant pages of the Annotated Grant Agreement and consult Horizon 2020 Online portal. Both explain each step during the implementation of the project. I would also recommend to be in contact with a National Contact Point (NCP) who is a good source for knowledge about both RISE and the local/national situation. Contact info available at https://ec.europa.eu/info/funding-ten-ders/opportunities/portal/screen/support/ncp.

Q.: How would you describe your "coaching" collaboration with project coordinators?

A.: Each project consortium is unique and may deal with very specific issues. I strive for a direct contact to ensure fruitful communication. I very much appreciate face-to-face meetings that we sustain via Coordinators' Day, Kick-off meetings organised in Brussels, Mid-term meetings, and any other RISE and project promotion events. I highly recommend having a conversation over the phone. That can significantly eliminate potential misunderstandings that may arise from an email exchange between non-native English speakers.

Q.:How many RISE projects do you "coach" in average, at the same time?

A.: For me personally, year 2018 was a transitional period when we had to finalise FP7 legacy projects. In 2017, I have started with portfolio of approximately 40 projects, both FP7 (IRSES, IOF) and H2020 (RISE). From 2019 on, I have portfolio of 18 RISE projects (2014-2018).

Q.: Now, let's talk a bit more in general of the RISE program…
What makes a RISE project "successful", from the Commission/REA point of view?

A.: The European Commission values innovations and market uptakes that come from projects funded by public money and increase Europe's competitiveness. From the implementation point of view of the funding Agency, successful projects meet all targets and show that tax payers' money was well spent. The indicators for success stories are: Sound project management, Discoveries/breakthroughs, Promising results, Media appeal, and Impact on EU policies. Moreover what we hear at our meetings with researchers is that they highly appreciate possibility to learn from other sectors, to get knew knowledge from experienced researchers, to network and to improve various skills in area of communication, dissemination, applying for grants, and meeting new cultures. We consider this as a proof of RISE scheme being a successful concept.

Q.: When is the next call for RISE projects?

A.: We have opened RISE2019 call on 4 December 2018. The deadline for submission is 2 April 2019. The last H2020 MSCA call, RISE2020 will be published on 5 December 2019 with a closing date on 7 April 2020.

Q.:How many projects are expected to be funded?

The budget for RISE2019 call is 80 million euros. Since RISE projects come in very different sizes it can be difficult to guess the number of funded in a given call but my guess would be around 80 projects. The information on past calls can be found at MSCA portal, Horizon 2020 Dashboard section available on the Funding and Tenders opportunity portal or via H2020 National Contact Points.

Q.:Which suggestions can you give to researchers planning to submit a proposal?

A.: The tip we heard from successful project coordinators is to start preparing a new project proposal even before the call is open. Search for suitable and committed partners, read carefully Work Programme, get good understanding of eligibility rules and find some help in Guide for applicants. And finally, consult local H2020 NCP. NCPs have regular updates on H2020 calls and are fully capable and willing to share advice with project coordinators even on draft project proposals.

REA DISCLAIMER: The views expressed are purely those of the writer and may not under any circumstances be regarded as stating an official position of the REA.

Secondments
experiences and results

At the date of publication of this issue we have executed more than 37 months of secondments.

We have 2 ERs seconded from International partners to European institutions. Other 4 ESRs and 11 ER have been seconded from European partners to International or non academic institutions. We have 10 male and 6 female.

We report a short summary of the secondee experience and research topics as emerged from their reports at the end of their secondments. We group the secondments based on the hosting institution.

NATIONAL RESEARCH COUNCIL (CNR), ITALY

Prof. Stan Matwin from Dalhousie University and Leopoldo Soares de Melo Junior from Federal University of Ceara' have been seconded to CNR. The main research activity of Prof. Matwin (who is the principal investigator of Dalhousie partner) has been to align each other about the recent results and trace the path for the future secondments to DAL, specifically about the WP3 topics. Leopoldo, instead, collaborated with CNR group in studying Machine Learning methods for very imbalanced datasets.

MUNICIPALITY OF THIRA (THIRA) SANTORINI ISLAND, GREECE

Four ERs have been seconded to our partner Thira in the Santorini Island (Greece). The municipality of Thira participates in the project to provide datasets and requirements for the tourism scenario. Santorini is a very famous destination and it is affected by the so called "overtourism" phenomenon, since it is receiving consistent flows of tourists from all over the world in a short time (essentially during Summer) and in relatively small space. The discussions of researchers from CNR, UNIVE and UVSQ have been focussed exactly in understanding the data currently available, how to collect more data and which kinds of analysis on these data could help Thira Municipality in building a DMO (Destination Marketing Organization). These researchers really enjoyed the experience of "hands on" a real application with everyday problems to

solve. Being there, they also experienced the practical problems that affect the island in receiving these huge flows of visitors and they feel stimulating that their research could one day improve the tourism management of Santorini.

FEDERAL UNIVERSITY OF SANTA CATARINA (UFSC), BRAZIL

Two ESRs from Harokopio University (Christos Sandianos and Antonio Makris) have been seconded to Federal University of Santa Catarina in Brazil, hosted by the principal investigator Prof. Vania Bogorny and her research group. The main topics of research of the two secondee has been the transformation of dataset's raw GPS data to points-of-interest To create a trajectory dataset enriched with multiple and heterogeneous contextual aspects (holistic trajectories). Also researchers worked in compression techniques to reduce the amount of data without serious information loss.

FEDERAL UNIVERSITY OF CEARA' (UFC), BRAZIL

One ER (Alessandra Raffaeta') from University of Venice Ca' Foscari in Italy and two ESRs from Harokopio University in Greece (Christos Sandianos and Antonio Makris) have been seconded to Federal University of Ceara' in Brazil, hosted by the principal investigator Prof. Jose de Macedo. Some of the topic of research of the two secondee has been to study the possibility of reconstructing trajectories from very sparse data (road sensors) and to tackle the problem of trajectory data compression using clustering. If an object remains static for a period of time, the dataset will contain a high number of points at the same location.

PONTIFICIAL UNIVERSITY OF RIO DE JANEIRO (PUC), BRAZIL

Three ERs, (Prof. Karine Zeitouni from University of Versallies Saint Quentin in France and Vinicius Monteiro de Lira and Cristina Muntean from National Research Council of Italy) have been seconded at the Pontifical University of Rio de Janeiro, in Brazil, hosted by the principal investigator Prof. Casanova. Their main research activity has been to better understand the transportation datasets (buses in Rio and Bike sharing) and the problems to be solved that can be useful to tune our analysis methods. Being in Rio de Janeiro they had also the possibility to do networking and dissemination activities visiting with colleagues of closeby Universities like Federal University of Rio de Janeiro (Dr. Livia Ruback, Prof. Jonice Oliveira) and Fluminense University (Prof. Luiz Andre' Paes Leme) to held seminars and establish new contacts there.

DALHOUSIE UNIVERSITY (DAL), CANADA

Dalhousie University hosted many MASTER secondees this first year! Prof. Stan Matwin from the Big Data Institute al Dalhousie University received five ERs

(Kostantinos Tserpes and Iraklis Varlamis from Harokopio University, Marta Simeoni from Universioty of Venice Ca' Foscari (Italy), Chiara Renso and Raffaele Perego from National Research Council of Italy) and one ESR (Elisabetta Russo from UNIVE). The topics of research have been many in the context of the sea monitoring thanks to the expertize of Dalh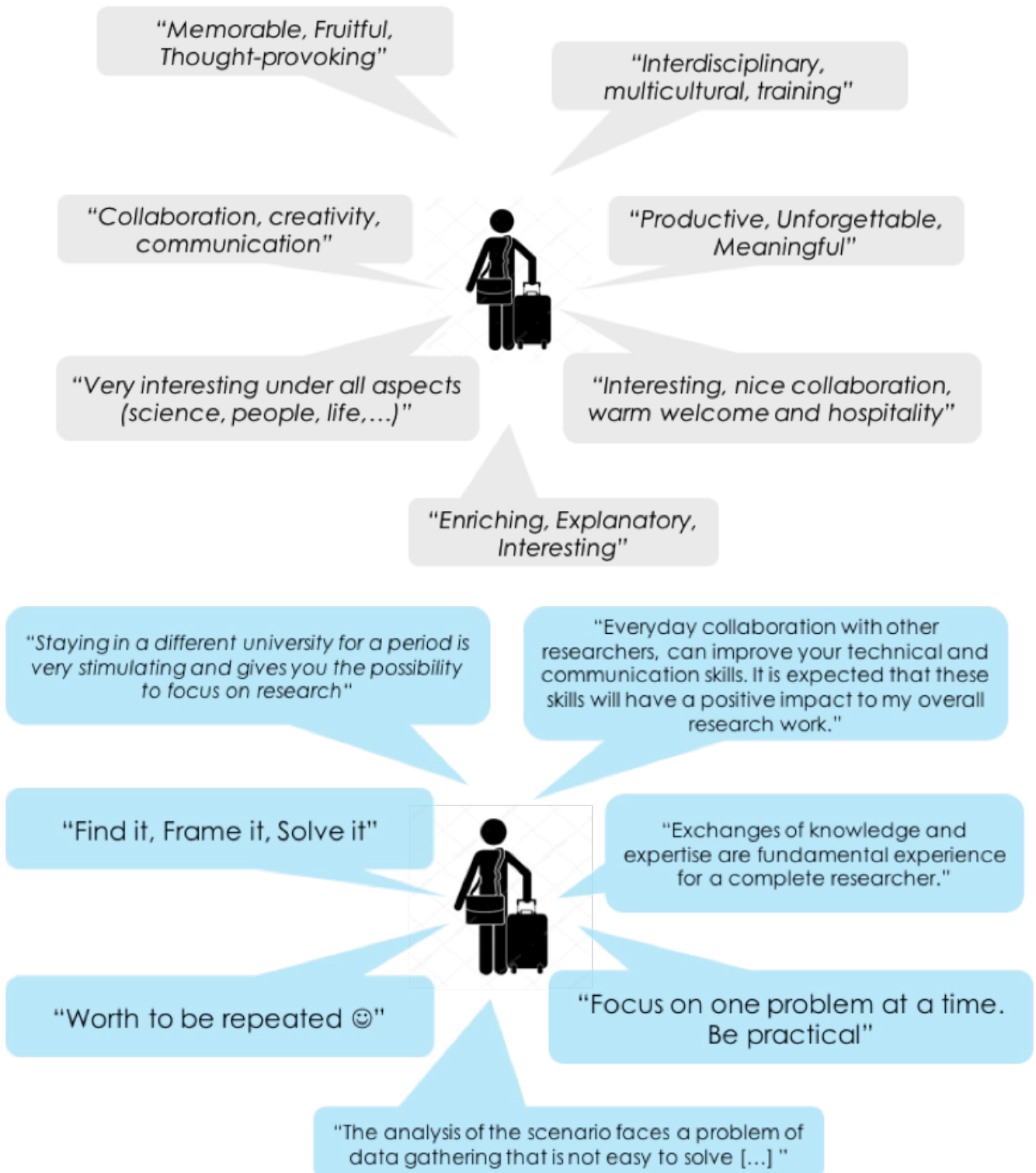ousie research group in this field and the large vessels trajectories datasets. Specifically, methods to create holistic trajectories from vessels have been developed.
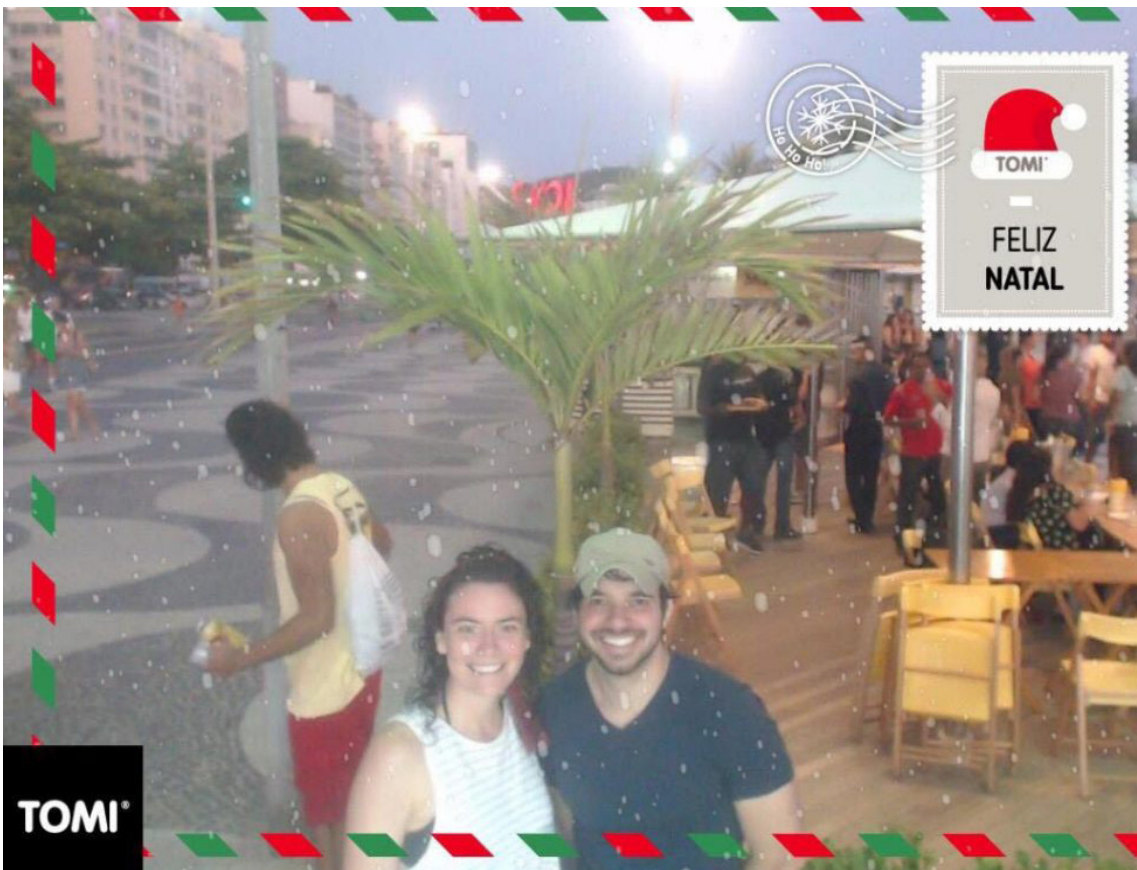
MASTER,

Secondments
Interview with secondees

We have asked our secondees in this first year their impressions feedbacks and "take home" messages

"Memorable, Fruitful, Thought-provoking"

"Interdisciplinary, multicultural, training"

"Collaboration, creativity, communication"

"Productive, Unforgettable, Meaningful"

"Very interesting under all aspects (science, people, life,…)"

"Interesting, nice collaboration, warm welcome and hospitality"

"Enriching, Explanatory, Interesting"

"Staying in a different university for a period is very stimulating and gives you the possibility to focus on research"

"Everyday collaboration with other researchers, can improve your technical and communication skills. It is expected that these skills will have a positive impact to my overall research work."

"Find it, Frame it, Solve it"

"Exchanges of knowledge and expertise are fundamental experience for a complete researcher."

"Worth to be repeated ☺"

"Focus on one problem at a time. Be practical"

"The analysis of the scenario faces a problem of data gathering that is not easy to solve […] "

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a Multiple Aspect View on Trajectories

Ronaldo Mello, Federal University of Santa Catarina, Brazil

For many years trajectory data have been treated as sequences of space-time points or stops and moves. However, with the explosion of the Internet of Things and the flood of Big Data generated on the Internet, like weather channels and social network interactions, which can be used to enrich mobility data, trajectories become more and more complex, with multiple and heterogeneous data dimensions. By collecting all these information we have a

as the emotional status of the staff using microphones. After work, the weather changes to rainy, and he decides to take a taxi to go to the restaurant. The restaurant has its own attributes, as open and close hours, average price, spatial location and reviews. This example highlights the existence of several possible aspects that are contextual to the movement and heterogeneous in the form. The main challenge is how to integrate all these information with trajectories.

for MATs. One of the most important concepts in this model is the Aspect. An aspect is a real-world fact that is relevant for trajectory data analysis, and it is characterized by an aspect type, like a bus that belongs to an aspect type transportation mode. An aspect type, in turn, has a set of attributes and it may also be a subtype of a more general aspect type, allowing the modeling of an aspect type subtypeOf hierarchy, like POI←accommodation←hotel. In fact,
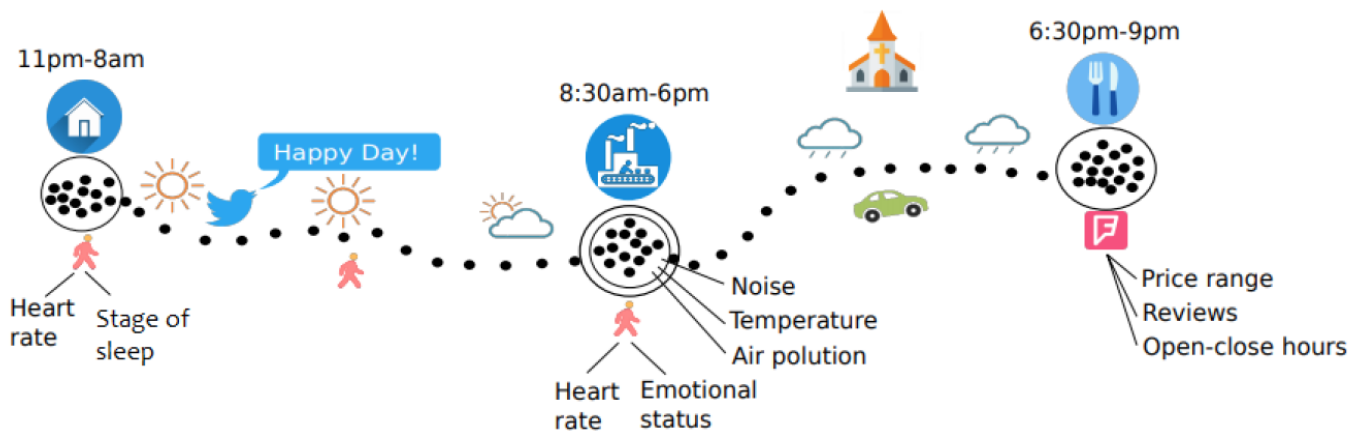
Figure 1. Example of a Multiple Aspect Trajectory

new type of movement data, i.e., a trajectory enriched with different semantic aspects. We call it Multiple Aspect Trajectory (MAT). Figure 1 shows an example of a MAT that details the movement of a man.

The man stays at home from 11pm to 8am, when he goes to work from 8:30am to 6pm, and finally moves for dinner to a restaurant. He has a smart watch that constantly collects his heart rate and his sleeping stages at home. He leaves home and goes to work on foot when the weather is sunny, and he tweets a message that characterizes his mood. His working place is a smart office equipped with sensors that collect information about the place as noise, temperature and air pollution, as well

We claim that multiple aspects represent a new view over trajectories, and a new paradigm concerning mobility data. In this work we introduce the concept of MAT and propose a novel approach for modeling this kind of trajectories called MASTER. MASTER comprises a conceptual and a logical data model for MATs, as well as a storage solution that is appropriate for MAT queries. The state-of-the-art regarding data models for trajectories focuses only on the conceptual representation, and do not go deeper in the logical level and storage technologies. Furthermore, they do not consider dynamic and complex aspects that involve movement, not being flexible to represent heterogeneous aspects.

Figure 2 shows our conceptual model

an aspect type and its attributes act as a metadata definition for an aspect, which let our conceptual model expressive to represent any semantic entity related to a trajectory in a simple way.

Our conceptual model also represents several meanings that an aspect may hold in the real world. We call it semantic meaning. One example is an aspect Sao Paulo, which may have the meanings of town, state, soccer team or the holy Sao Paulo. These meanings are categorized by a specific aspect type. Additionally, an aspect with a semantic meaning can be associated to a MAT, a trajectory point, a moving object, or a relationship between moving objects. It provides flexibility to relate a semantic context to a trajectory as a whole, to

part of a trajectory, or even to a person or other kind of moving object that has permanent semantic features. We also consider spatial features and events. The first one denotes any relevant POI that is located in the trajectory neighborhood, like a nearby restaurant. and may be useful for answering spatial queries like the restaurants located at a given distance from the object movement. Similarly, an event denotes a close happening that may be also relevent for queries.

Our data modeling approach also proposes a conversion of the conceptual data model to a logical data model in the Resource Description Framework (RDF). RDF is a graph-based data structure that is expressive to represent the high heterogeneity of possible aspects, as well as the great number of aspect relationships with trajectories, points and mov-

ing objects. Besides, on using RDF we are consonant with the Semantic Web standards for publishing and manipulating data on the Web. Finally, we adopt, as the storage solution, a triplestore based on NoSQL databases for maintaining RDF data, since these databases are an efficient technology to maintain and query very large data volumes, including trajectory data.

We performed a twofold evaluation of MASTER. A qualitative evaluation was accomplished over a tourism application domain, which demonstrates the expressiveness of MASTER to represent different types of trajectory aspects when compared to related work. We also ran a quantitative experiment, where MASTER outperformed, in terms of efficiency in query processing, a state-of-the-art competitor: the spatio-temporal database Secondo.

Future works regarding MASTER include a performance evaluation over other storage technologies, such as NewSQL databases, for maintaining MATs. We also intend to extend MASTER to model data analytics information over MATs, considering, for instance, dependencies among aspects. Besides, a MASTER extension to support alignment with existing ontologies or other semantic data sources (e.g., LOD) is under consideration.
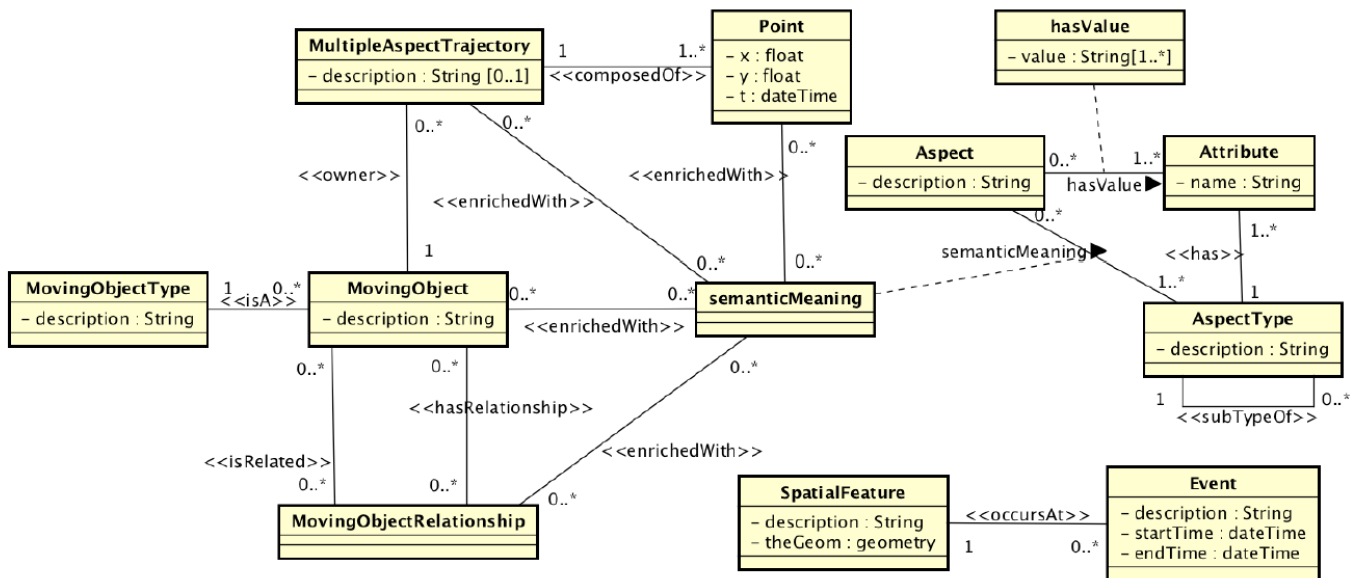

Figure 2. The Conceptual Model for Multiple Aspect Trajectories.

MASTER

Vista

a visual analytics platform for semantic annotation of trajectories

Amilcar Soares, Dalhousie University, Canada

Most of the trajectory datasets only record the spatio-temporal position of the moving object, thus lacking semantics. This is due to the fact that this information mainly depends on the labelling action of a domain expert, a time-consuming and complex process. As a contribution in facilitating and supporting the manual annotation of trajectory data, we propose a visual-analytics-based platform named VISTA. VISTA is designed to assist the user in the trajectory annotation process in a multi-role user envi-

VISTA is the visual analytics functionalities that support the users in exploring and processing the trajectory data, the associated features and the semantic information for a proper comprehension of how to properly label trajectories.

The architecture and workflow overview is illustrated in Figure 1. As we can see, it is organized into three main components: (i) the data collection to handle raw trajectory and contextual geographical information like Point of Interests

jectory annotation includes six steps depicted as the numbers of the arrows of Figure 1. In the first step, the session manager is requested to set the stage for the annotation process, namely upload raw trajectories and the POIs and ROIs that are relevant to the studied domain. In the following step (Step 2), the data processing engine automatically creates numerical features related to each trajectory point, called point features like the distance traveled, the estimated speed, the bearing, the bearing
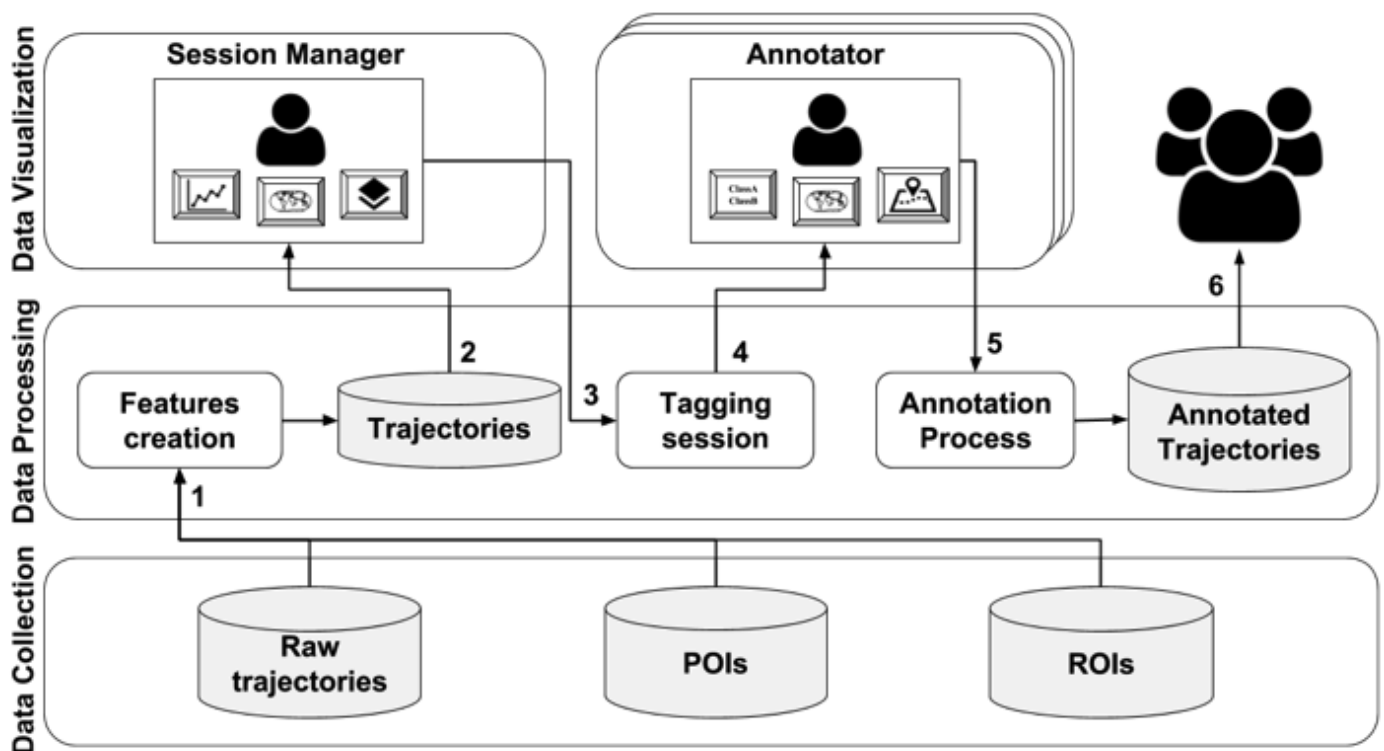

Figure 1 – Vista architecture and workflow

ronment. A session manager creates a tagging session selecting the trajectory data and the semantic contextual information. The VISTA platform also supports the creation of several features that will assist the tagging users in identifying the trajectory segments that will be annotated. A distinctive feature of

(POI) and Region Of Interests (ROI), (ii) the Data Processing that deal with trajectory and annotation data, and (iii) the Data Visualization to interact with the users in the processes of both creating a tagging session, detect the switch points and annotating trajectories.
The workflow of VISTA to perform tra-

rate, and the acceleration. The engine also calculates the shortest distances to a POIs, and detects when the trajectory points intersect with ROIs. At this point, each trajectory uploaded by the user is stored as a document in a MongoDB collection. In step 3, VISTA displays the trajectories associated to these new

features to the session manager whose tasks are: (1) the data exploration for the selection of the features that are relevant for the tagging session, (2) the creation of the annotation classes (i.e. labels) that must be used in a tagging session, and (3) the invitation to the annotator users to participate in a tagging session. With a tagging session created, it is now possible for the invited annotators to start the tagging process of trajectory data. In step 4, the annotators explore the trajectory data and create the trajectory segments that must reflect the annotation classes available for tagging. After going through all trajectories and tagging their segments with the labels (Step 5), a dataset with annotated trajectories will be available for all the users to download (Step 6).

VISTA is an interactive tool based on visual analytics principles, supporting the users in semantically annotate trajectory data (please visit **https://bigdata.cs.dal. ca/resources** for testing the platform).

A distinctive feature of VISTA is the support for the identification of trajectory segments and the assignment to the relative semantic label. We intend to expand this platform into two directions. First, we want to create a module that automatically suggests how to segment the trajectory by learning from the previous interactions with the platform. Second, we intend to improve the results comparing how the labels have been assigned by the different users, highlighting when users agree or disagrees in identifying a specific behavior of a moving object.
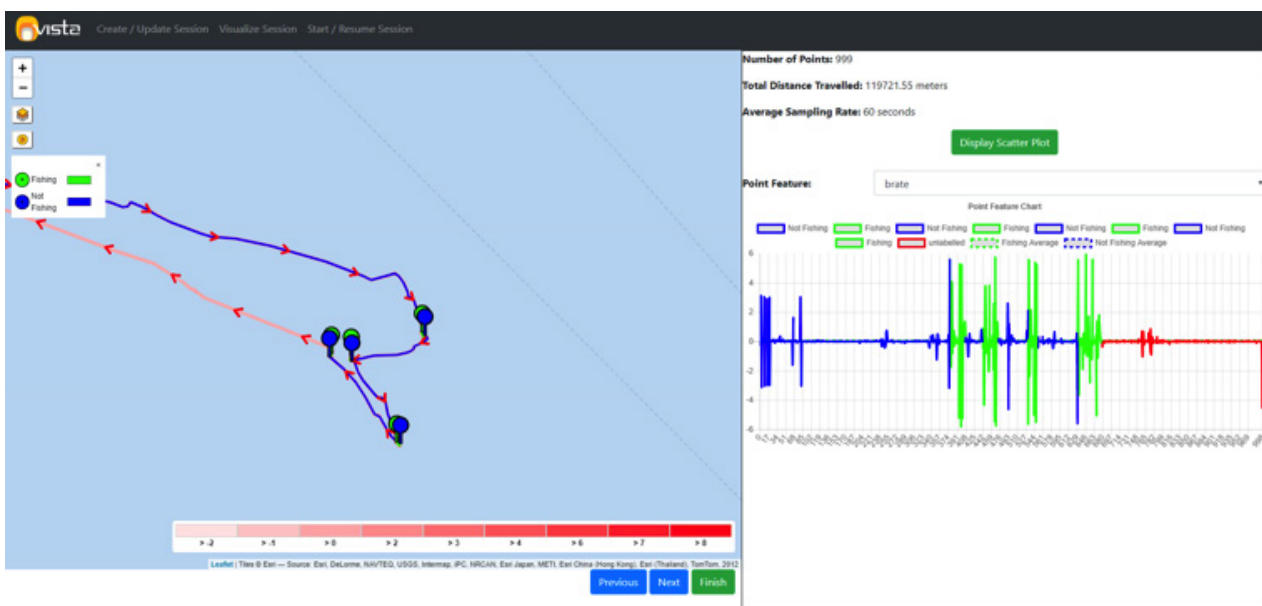

Figure 2 Trajectory segmentation with VISTA

Past and Next Events

Our partner, Prof. Stan Matwin from Dalhousie University, Halifax, Canada, has been invited to give a talk about the MASTER experience in the "Transatlantic Research for Impact: Featuring best practices of scientific collaboration" session at the **European Research Day** on the 5th of November 2018 in Ottawa (Canada).

EURAXESS is an organization supporting researcher mobility and career development, while enhancing scientific collaboration between Europe and the world. It is sponsored by the European Union and its Member States. EURAXESS North America looks after the activities of the organization in the context of the USA and Canada. On Nov. 5, EURAXESS NA had its first ever meeting in Canada, hosted by the University of Ottawa. This European Research Day titled "**Transatlantic Research for Impact: Featuring best practices of scientific collaboration**" included panels, presentations and information booths on different aspects of research personnel exchanges

between Europe and US and Europe and Canada.

Dr. Stan Matwin, as a Canadian MSCA Fellow and a MASTER Canadian partner, took part in the panel "Transatlantic Research for Impact Featuring best practices of scientific collaboration".

Congratulations to Christos, Irakli and Grigoris from Harokopio partner (Greece) for their paper "Extracting User Habits from Google maps history logs" published at the **ASONAM conference** held in Barcelona (Spain) from 28 to 31 August 2018.

MASTER is supporting the Big Mobility Data Analytics Workshop to be held in conjunction to **EDBT conference** in Lisbon on March 25, 2019. Congratulations to researchers from our partners Dalhousie (Canada), Harokopio (Greece) and Versailles Saint-Quentin (France) Universities for having their papers accepted at the event! More infos at http://www.datastories.org/bmda19/

MASTER is also supporting the organization of the workshop **FATES** on the Web 2019, 1st Workshop on Fairness, Accountability, Transparency, Ethics, and Society on the Web, in conjunction with **The Web Conference 2019** to be held next May 14, 2019 in San Francisco, CA, USA. Congratulations to MASTER researchers from University of Pireaus (Greece) for having their paper accepted! Program available at http://fates19.isti.cnr.it

An up-to-date detailed list of past and current events are listed in the News section of the MASTER web site, please have a look!
http://www.master-project-h2020.eu/category/news/

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