EPSC2017

OEP1 abstracts

EPSC Abstracts
Vol. 11, EPSC2017-219-1, 2017
European Planetary Science Congress 2017

Europlanet-2020 NA1 Exchange Program

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1. Introduction

Innovation in the area of planetary science is driven by the demanding environments in which spacecraft and their instruments must work, by the large datasets and challenging observations that must be made to understand planetary systems, and by the sheer curiosity of humans as a species to understand their own world in relation to the others we have found and are finding. Europlanet 2020 Research Infrastructure work package NA1 "Innovation through science networking" provides the key scientific backbone of EPN2020 and focuses on the human resources of the project itself and beyond - on researchers and engineers working in the field of planetary exploration in the ERA, contributing to overall capacity building in Europe. One of the tasks inside NA1 is the Exchange Program (Task 6) providing support to the activities of EPN2020 with exchange of experts.

2. Exchange Program Objectives

The Expert exchange task supports the activities of EPN2020 with experts and scientific exchange whenever it is needed. One of the objectives is to support exchange and foster cooperation between academia and industry (SMEs), and to provide benefits beyond the individual participants to the broader European community. At least one exchange recipient must be a beneficiary of EPN2020. The task involves coordination of Expert Exchanges and support to Young Scientists.

The Expert exchange program funds short visits (up to 1 week) with the goal of improving infrastructure facilities and services offered to the scientific community by the EPN2020 participant (contractor) laboratories or institutes. The main objectives of the program include:

- Support the integration of the inclusiveness states with the European planetary community
- Support and engage young scientists with the European planetary science community
- Support exchange and foster cooperation between academia and industry (SMEs)
- Support the inclusion of amateur communities in European planetary science campaigns
- Support the activities of EPN2020 with exchange of experts

3. Exchange Program Calls

Several calls for applications to the Exchange program have been issued, with future calls planned on regular basis. The summary of past and currently open calls is given in the table below.

Table 1: Exchange program calls, past and current

Call	Received applications	Approved applications
Call 1	2	2
Call 2	4	4
Call 3	1	1
Special call for IPPW-14	7	7
Call 4	open	

14 applications in total have been received and approved at this point. In order to get reimbursed, the chosen applicants provide the report of the visit after concluding their visit. The countries involved in the visits either as the originating country or the visited country so far are: Portugal, France, Finland, Denmark, UK, Czech republic, Hungary, Germany, Italy and Greece.

4. Summary and Conclusions

The task of Exchange Program of NA1 is to support the activities of EPN2020 with experts and scientific exchange whenever it is needed. Short visits (up to 1 week) with the goal of improving infrastructure facilities and services offered to the scientific community are supported from this task. Since the start of the EPN2020 in September 2015 we have received and approved 14 applications for exchange program travel. More general and specifically targeted calls are planned for the future. The calls are announced on Europlanet-2020 NA1 web site.

Acknowledgements

Europlanet 2020 RI has received funding from the European Union's Horizon 2020 research and innovation proramme under grant agreement No 654208.

References

Europlanet-2020 RI main web site:
http://www.europlanet-2020-ri.eu

NA1 WP web page:
http://fmispace.fmi.fi/index.php?id=na1epn2020

Exchange Program web page:
http://fmispace.fmi.fi/index.php?id=exchange

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Vol. 11, EPSC2017-245, 2017
European Planetary Science Congress 2017

Orbit Modeller — Virtual Astronomical Laboratory

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Abstract

The celestial mechanics and astrometry department of Tomsk State University presents a virtual astronomical laboratory project — "Orbit Modeller" (OM). This should be an interactive web-tool enabling one to simulate numerically the orbital motion of any celestial body both within the solar system and beyond it. Another function of OM is a repository of old observations and documents.

1. Introduction

Our department exists about 40 years and we accumulated a huge amount of astronomical software. This year our university joined to the Europlanet Consortium, what motivated us to bring our soft libraries in order and to make them accessible to the scientific community.

The laboratory tools are designed for simulation of motion of the following space objects: I) AES (unguided artificial Earth satellites, including space debris); II) Asteroids and comets; III) Natural satellites (mainly outer satellites of the giant planets); IV) Meteoroids; V) Exoplanets.

The differential equations of motion are integrated numerically. The model of forces in the equations depends on what kind of orbit is simulated. For example, the most complicated model is for AES [1]. It includes: the gravity of the nonspherical Earth, other major planets, Sun and Moon; the influence of Earth atmosphere and solar radiation pressure; relativistic and other weak effects. Another example is meteoroids' motion, where the force model could include radiation and relativistic effects [2].

2. The first-selection tools

The first stage of our project is developing the user interface for existing programs and subroutines modelling the asteroid and AES motion.

The span of the orbit simulation is limited by that of the JPL DE (ftp://ssd.jpl.nasa.gov/pub/eph/planets/) which is used for computing the positions of solar system massive bodies, which are required in the model of forces.

The differential equations are integrated by Everhart method [3]. The observation-based orbit refinement (differential correction) is realized by the Gauss–Newton method [3].

3. The document repository

Our department inherited the archive of data of radar observations of Geminid, Quadrantid, Daytime Arietid, Perseid, Ursid, Lyrid, Orionid and Leonid meteor showers in Tomsk in 1965–1966 [4]. We scanned thousands of handwritten pages of the meteor echoes measurements having in mind to open these data to research community.

In addition to usual software manuals, we plan to form a small library of related publications (in Russian and English).

4. What next?

Besides the mentioned tools and divisions, we are going to add educational and outreach parts, e.g. a playing room with interactive orbital models.

We plan to launch the first stage of this project and our web site by the 2017 end. Realization of the next stages depends on the available financial support.

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Vol. 11, EPSC2017-269, 2017
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Joint activity together with ISSI and EP-NA1/WP12

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Abstract

The International Space Science Institute, Bern, (ISSI) is a Beneficiary of the EUROPLANET consortium and a member of the Europlanet 2020 RI council. However, as Switzerland is not a member of European Union, ISSI does not receive any funding from the EP project, it covers the cost of participation from Swiss resources. Between 2015-2019 in the framework of WP12, the networking activity NA1 (Innovation through Science Networking) is holding three one-week workshops on key cross-disciplinary topics at the International Space Science Institute; and two Planetary Science Strategy Workshops will be organized. The details of this cooperation will be presented.

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Vol. 11, EPSC2017-278-1, 2017
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Policy Activites in Europlanet 2020 RI

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Abstract

The Europlanet 2020 Research Infrastructure (RI) has received 9.945 million Euros from the European Commission to integrate planetary science across Europe, provide access to facilities, develop tools and build community cohesion. To help these processes and to increase engagement between our policy makers and the planetary science community, part of Europlanet 2020 RI's efforts are dedicated to building connections and organising activities for and within the European Parliament.

Since September 2015, Europlanet 2020 RI has contacted all 134 Members of the European Parliament (MEPs) on the ITRE Committee. More than 20 individual briefings have been held to date with MEPS and/or their representatives. In November 2016, Europlanet 2020 RI organized a very successful exhibition in the European Parliament as part of the 8th European Innovation Summit and the STOA Annual Lecture, and a dinner debate was held on the topic 'Impact of the EU on planetary science' in April 2016.

These events enable members of the Europlanet community, politicians and interested parties to come together and discuss views on topics of interest or concern to the space and planetary sectors. Efforts in recent years have led to important opportunities for our community to feed into reporting and consultative processes. In this talk we will discuss the results achieved in the last two years of activities and the next steps foreseen by Europlanet 2020 RI.

Acknowledgements

We acknowledge Steve Miller (Impact Officer) and Veronika Raszler (Policy Officer) for their previous contributions to this activity for Europlanet.

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Vol. 11, EPSC2017-400, 2017
European Planetary Science Congress 2017

Developing a user-friendly photometric software for exoplanets to increase participation in Citizen Science

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Abstract

Previous research on Citizen Science projects agree that Citizen Science (CS) would serve as a way of both increasing levels of public understanding of science and public participation in scientific research. Historically, the concept of CS is not new, it dates back to the 20th century when citizens where making skilled observations, particularly in archaeology, ecology, and astronomy. Recently, the idea of CS has been improved due to technological progress and the arrival of Internet. The phrase "astronomy from the chair" that is being used in the literature highlights the extent of the convenience for analysing observational data. Citizen science benefits a variety of communities, such as scientific researchers, volunteers and STEM educators. Participating in CS projects is not only engaging the volunteers with the research goals of a science team, but is also helping them learning more about specialised scientific topics. In the case of astronomy, typical examples of CS projects are gathering observational data or/and analysing them. The Holomon Photometric Software (HOPS) is a user-friendly photometric software for exoplanets, with graphical representations, statistics, models, options are brought together into a single package. It was originally developed to analyse observations of transiting exoplanets obtained from the Holomon Astronomical Station of the Aristotle University of Thessaloniki.

Here, we make the case that this software can be used as part of a CS project in analysing transiting exoplanets and producing light-curves. HOPS could contribute to the scientific data analysis but it could be used also as an educational tool for learning and visualizing photometry analyses of transiting exoplanets. Such a tool could be proven very efficient in the context of public participation in the research. In recent successful representative examples such as Galaxy Zoo professional astronomers cooperating with CS discovered a group of rare galaxies by using online software. Also the project "planet hunters" asked people to discover planets in other solar systems using data from large telescopes. HOPS, being in the same direction, could be an effective way of participating in research whether as an amateur astronomer or as a person of the general public that wants to engage with exoplanetary research and data analysis. The software is free of charge under the scope of astronomical research and education. We plan to create an online platform, inspired by HOPS, in the near future. In this platform, everyone will have access by creating an account as a user. Amateur astronomers, who have obtained their own exoplanet observations, will be able to upload and analyse their data. For people who are not familiar with photometric analysis – amateurs or general public users – data, as well as educational video and audio material will be provided.

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Vol. 11, EPSC2017-479, 2017
European Planetary Science Congress 2017

Impact Through Outreach and Education with Europlanet 2020-RI

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Abstract

The Europlanet 2020 Research Infrastructure (RI), funded through the EC's Horizon 2020 programme, was launched in 2015 to support Europe's planetary science community and provide services, access to facilities, new research tools and a virtual planetary observatory. The exploration of our Solar System has long been recognised as a potential 'hook' for attracting people with many diverse backgrounds and interests into science. Europlanet 2020 RI's Impact Through Outreach and Education (IOE) activities aim to engage the widest possible community with the work of Europlanet 2020 RI, and to involve the public, the media, policy makers, educators and students with the ongoing adventure of planetary science and the people that work in the field.

Europlanet 2020 RI's IOE activities have used a range of outreach tools and communication channels to target engagement with different audiences, including:

- The public: through social media, animated videos and through public events and conferences;
- Teachers/students: through webinars, events, peer-reviewed collections of educational resources, videos and careers information;
- Policy makers: through briefings, exhibitions, dinner debate briefing sheets and written evidence;
- The media: through press releases, media briefings and interviews;
- Outreach professionals: through best practice meetings, outreach sessions at EPSC and conferences.

In addition, the annual Europlanet Prize for Public Engagement and the Europlanet Outreach Funding Scheme support outreach efforts within the planetary science community.

EPSC 2017 will mark the half-way point of the Europlanet 2020 RI project. This talk will review the achievements of Europlanet 2020 RI's outreach activities to date and look ahead to objectives and tasks for the final two years of the project.

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Vol. 11, EPSC2017-616, 2017
European Planetary Science Congress 2017

Inclusiveness program – a SWOT analysis

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Abstract

The Inclusiveness Program was created with the aim to integrate currently under-represented countries into the mainstream of European planetary research. Having a wider, less homogeneous scientific community will boost competition, economic development and scientific results. Expanding the European concept to the Eastern parts can also increase cost effectiveness.

Main stages of the working plan include setting up a database containing all the research institutes and universities where astronomical or geophysical research is carried out. It is necessary to identify their problems and needs. Challenging part of the project is to find exact means that help their work in a sustainable way. The most common response is the need of money, but it is the objective of Europlanet, that any funding given is not money down the drain, but money as capital, with a long-term effect.

Strengths, weaknesses, opportunities and threats of the program were identified based on feedback from the inclusiveness community. Our conclusions, further suggestions are presented.

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Vol. 11, EPSC2017-714, 2017
European Planetary Science Congress 2017

The Radio Meteor Zoo: searching for meteors in BRAMS radio observations

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Abstract

The Radio Meteor Zoo is a citizen science project where users are asked to identify meteor echoes in BRAMS radio data obtained mostly during meteor showers. The project will be described in details and preliminary results obtained during the Perseids and Geminids 2016, Quadrantids 2016 and 2017, and Lyrids 2017 will be presented.

1. Introduction

BRAMS (Belgian RAdio Meteor Stations) is a Belgian radio network using forward scattering of radio waves to detect and study meteoroids falling in the Earth's atmosphere. The network comprises a dedicated beacon transmitting a continuous sin wave with a frequency of 49.97 MHz and a power of 150 watts. 30 receiving stations are spread all over the Belgian territory.

BRAMS data are saved every 5 minutes as an audio WAV file. They are usually presented as spectrograms which span 200 Hz and are centered on the direct signal coming from the beacon. An example of spectrogram including underdense and overdense meteor echoes is shown in Figure 1.

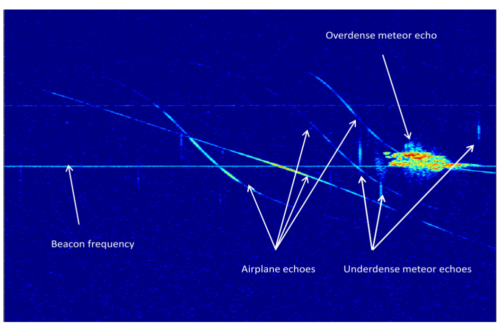

Figure 1: example of a BRAMS spectrogram

Every day more than 8000 WAV files are generated via the BRAMS network and contain thousands of meteor echoes. Therefore automatic detection methods of meteor echoes must be used. Two methods have been developed by the BRAMS team. They work fairly well for underdense meteor echoes but are always complicated by the presence of airplane echoes and/or local noise. In order to assess the quality of these algorithms, we need to estimate the true positive and true negative rates provided by each method. For that purpose, manual counts are used based on an in-house tool developed to draw rectangles around meteor echoes in spectrograms.

Another difficulty comes from the overdense meteor echoes which can display very complex and varied forms in spectrograms. During meteor showers a lot of these overdense echoes are observed and therefore the reliability of automatic detection algorithms is questionable. An example is provided in Figure 2 obtained during the Perseids 2016. In this case the human eye stays the best detector.

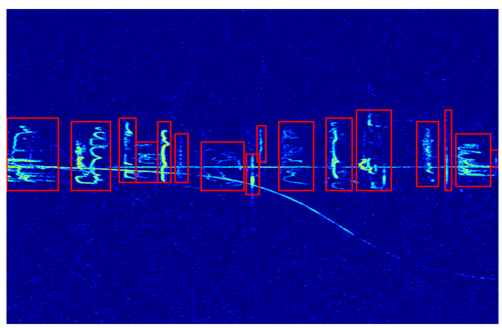

Figure 2: an example of a BRAMS spectrogram obtained on August 12 during the Perseids 2016. The red rectangles are manual detections of meteor echoes.

2. The Radio Meteor Zoo

In summer 2016, the BRAMS team launched the citizen science project "The Radio Meteor Zoo" (www.radiometeorzoo.eu) in collaboration with people at Zooniverse (www.zooniverse.org). The idea is to ask citizen scientists to inspect the BRAMS spectrograms obtained during meteor showers and draw rectangles around meteor echoes. A tutorial has been provided to briefly teach the user on what is a spectrogram, what are the various signals that can be seen in it and how to differentiate a meteor echo from other signals. So far, more than 22000 images have been analyzed and about 4600 users have registered. The Radio Meteor Zoo (RMZ) website will be presented in details during the talk.

In order to be able to analyze the RMZ contributions, we must be able to answer the following important questions: 1) what is the minimum number of volunteers needed to inspect a given spectrogram? 2) in a given spectrogram, how can we accurately derive the number and position of meteor echoes based on individual contributions? For that, a small-scale test was made with 12 spectrograms and about 35 test-users allowing us to decide that each spectrogram should be inspected by 10 users and that a given pixel on the image should be considered as being part of a meteor echo if it is included in at least 4 rectangles drawn by different users. In that way, we minimize the number of false positive and false negative rates without the need of requesting too many identifications. Individual connected pixels are then included in a potential meteor echo by drawing the largest rectangle including them.

3. Preliminary results

Figure 3 shows an example of a spectrogram inspected by 10 users (red rectangles) and the selected potential meteor echoes based on the method described above. As can be seen most meteor echoes are detected correctly although sometimes two meteor echoes close to each other are included in a single detection.

BRAMS data from the Perseids and Geminids 2016, Quadrantids 2016 and 2017, and Lyrids 2017 have been analyzed by RMZ users. The results will be presented. An example of results is given in Figure 4. It is the activity curve of the Perseids 2016 constructed by using only meteor echoes with a duration longer than 10 seconds (overdense meteor echoes).

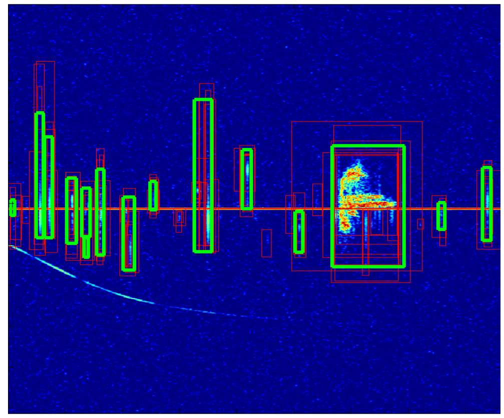

Figure 3: example of a spectrogram inspected by 10 Radio Meteor Zoo users (red rectangles). The green rectangles are aggregated rectangles and correspond to the meteor echoes detections.

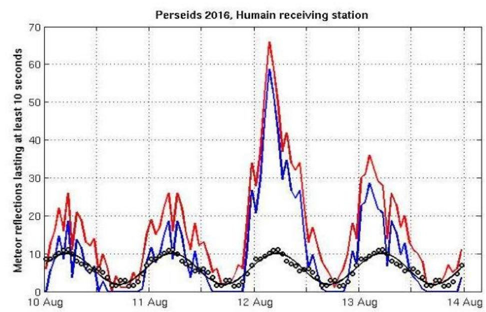

Figure 4: Activity curve of the Perseids 2016 using results from the RMZ users and meteor echoes lasting more than 10 seconds. Red curve is total activity, black dots are background activity (with a sine fit) and the blue curve is the estimated raw activity from the Perseids only.

4. Summary and Conclusions

The RMZ proves to be extremely popular and works fairly well. Preliminary results will be shown and planned improvements will be discussed.