Frequency Allocations in Remote Sensing Technical Committee (FARS-TC)

Annual Meeting
IGARSS 2023
Pasadena
July 18, 2023
Content

- **GUEST SPEAKER**: Yan Soldo
  The need of reliable spectrum to ensure the success of your space mission

- **FARS ANNUAL MEETING**
  FARS Introduction & New Chairs
  PocketQube initiative
  GRSS Views on WRC23 initiative
  IEEE Standard on RFI quantification initiative
  Spectrum Management
  Conferences and Outreach

**DISCUSSION**
Introduction

The Frequency allocations in Remote Sensing Technical Committee goal is to *interface between GRSS and the radio-frequency regulatory world* by

- educating the remote sensing community on spectrum management processes and issues
- promoting the development of radio frequency interference detection and mitigation technology
- organizing technical sessions at conferences, workshops, etc. on the above processes, issues and technologies
- providing spectrum managers and regulators with technical input and perspective from remote sensing scientists and engineers
- fostering the exchange of information between researchers in different fields, such as remote sensing, radio astronomy, telecommunications, etc. with the common scope of minimizing harmful interference between systems
FARS-TC Chairs

- **Outgoing:**
  - Chair: Roger Oliva
  - Co-chairs: Paolo de Matthaeis, Ming-Liang Tao

- **Incoming:**
  - Chair: Paolo de Matthaeis
  - Co-chairs: Ming-Liang Tao, Beau Backus
ONGOING INITIATIVES
PocketQube

- Following the outcome of WRC19 and the discussions at the 2019 and 2020 FARS-TC Annual Meetings regarding the concerns for the 5G deployment, FARS launched an initiative to develop a PocketQube with RF monitoring capabilities at 24 GHz to follow the deployment of 5G and its impact on this remote sensing frequency band.

- The PocketQube was added to the list that UPC through a GRSS educational initiative was developing that included two PocketQubes (5cm x 5cm x 5cm):
  - Optical Payload.
  - RF Payload at L-band
  - RF Payload at 24.5 GHz
PocketQube

Focus on assessing presence of 5G out-of-band signals reaching the 23.6-24 GHz protected band

- Measure RF power with a RSSI in the band from 24 to 25 GHz in 10 MHz channels, +30 dB INR interferences.
- To be used in Drone Campaigns for assessing sites with 5G deployment at 24 GHz.
- Possibility for PocketQubes to be launched with the UPC NanoSat Lab custom CubeSat integrated deployer within the future ³Cat-8 mission (TBC).
PocketQube Test Campaigns

Attach PocketQube to a drone to perform flight campaigns in Spain.

**Drone Campaign**

- Drone test campaign to validate payload operability
- 5-6 flights over crops field
- **Objective**: Detect hidden RFI emitters
  - 24 GHz COTS radar modules
- Detections based on time and frequency pulse thresholding, as well as statistical analyses
## GRSS Views on WRC-23 Agenda Items

<table>
<thead>
<tr>
<th>WRC-23 Agenda Item</th>
<th>Service</th>
<th>Frequency Bands under consideration</th>
<th>EESS Bands Potentially Affected</th>
</tr>
</thead>
</table>
| 1.2                | International Mobile Telecommunications (IMT) | 3300-3400 MHz  
3600-3800 MHz  
6425-7025 MHz  
7025-7125 MHz  
10.0-10.5 GHz | 3100-3300 MHz (active)  
10.6-10.7 GHz (active)  
6425-7075 MHz (passive)  
7075-7250 MHz (passive)  
10.6-10.7 GHz (passive) |
| 1.4                | High-altitude platform stations as IMT base stations (HIBS) | various bands between 694 and 2690 MHz | 2690-2700 MHz (passive) |
| 1.12               | Earth Exploration Satellite Service (EESS) active | 40-50 MHz | 40-50 MHz (active) |
| 1.10               | Non-safety aeronautical mobile service | 15.4-15.7 GHz  
22.2-22.1 GHz | 22.2-22.1 GHz (passive) |
| 1.14               | Earth Exploration Satellite Service (EESS) passive | 231.5-252 GHz | 235-238 GHz (passive)  
250-252 GHz (passive) |
| 1.15               | Earth Station in Motion (ESIM) services | 10.7-10.95 GHz  
13.25-13.75 GHz  
17.2-17.3 GHz | 10.6-10.7 GHz (passive)  
13.25-13.75 GHz (active)  
17.2-17.3 GHz (active) |
| 1.16               | Earth Station in Motion (ESIM) services for Non GSO Fixed-Satellite Service (FSS) | 17.7-18.6 GHz (space-to-Earth)  
18.8-19.3 GHz (space-to-Earth)  
19.7-20.2 GHz (space-to-Earth)  
27.5-29.1 GHz (Earth-to-space)  
29.5-30 GHz (Earth-to-space) | 18.6-18.8 GHz (passive) |
| 1.17               | Satellite-to-satellite links | 11.7-12.7 GHz  
18.1-18.6 GHz | 18.6-18.8 GHz (passive) |
| 1.18               | Mobile-Satellite Service (MSS) | 1695-1710 MHz,  
2010-2025 MHz,  
3300-3315 MHz,  
3385-3400 MHz; | 3100-3300 MHz (active) |
| 1.19               | Fixed-Satellite Service (FSS) space-to-Earth | 17.3-17.7 GHz | 17.2-17.3 GHz (active) |
| 9.1 (b)            | Amateur and Amateur-satellite services | 1240-1300 MHz | 1215-1240 MHz (active)  
1240-1300 MHz (RNSS) |
| 9.1 (d)            | Non-GSO FSS space stations | 37.5-38 GHz | 36-37 GHz (passive) |
GRSS Views on WRC-23 Agenda Items

- WRC Agenda items with potential impact on the remote sensing Frequency bands.
GRSS Views on WRC-23 Agenda Items

- FARS WRC WG has produced, for the first time, a document summarizing the IEEE-GRSS Views on the WRC Agenda Items related to remote sensing.

- Concerns and opportunities from the GRSS perspective on the proposed modifications to the Radio Regulations are discussed.

- We would like to share this document with volunteer members from FARS-TC for a final consolidated version to be released in the coming months.

Special thanks to: G. De Amici, R. Natsuaki, T. Bollian, J. Johnson, A. Bringer, D. Le Vine, A. Camps, D. Lubar, L. Carrer, P. Mohammed
FARS-TC and Standards Committee

- FARS-TC triggered the development of an IEEE Standard to define a methodology to quantitatively evaluate the amount of man-made Radio Frequency Interference (RFI) in any given frequency band allocated to space-based remote sensing.
- Useful in understanding the situation of all the bands allocated to remote sensing, follow their trends and in defining priorities for our spectrum managers.
- After several meeting and discussions, the activity entered the stage of writing down the first draft.
- We welcome all our members to join.
Initial Flowchart:

Step 1 - RFI Detection
Acquisition-Reference-Frame

Step 2 – RFI Maps (per Sensor)
Sensor-Reference-Frame

Step 3 – RFI Maps
Global-Reference-Frame

Step 4 – Output products
RFI characterization

The RFI in Remote Sensing Working Group,

• 28 Participants from different countries
• 20 Voting Members

We’ve hold 11 Working Group Meetings, and many sub-group meetings
SPECTRUM MANAGEMENT ACTIVITIES
Spectrum Management Meetings (1/4)

- IEEE-GRSS continues to be recognized as an important independent player in spectrum management discussions. FARS participated at the following Meetings

- **ITU-R Study Groups:**
  - Working Party 7C (Remote Sensing Systems)
  - Working Party 3J (Radiowave Propagation)
  - Space Frequency Coordination Group (SFCG)
Spectrum Management Meetings (2/4)

Accomplishments at Working Party 3J

- FARS-TC co-lead the development of two new ITU-R Recommendations:
  - ITU-R P.2146 *Sea surface bistatic scattering*
  - ITU-R P.2148 *Digital maps related to surface wind speed statistics*

- This new recommendations are already being used for sharing and compatibility studies in the latest meetings, notably WP 7C and WP 4A.
Accomplishments at Working Party 7C

- Further advancement of the report on interference at 18 Ghz caused by reflection of broadcast signals over the ocean surface;
- Involvement in the process of developing the conditions for the new secondary allocations to radar sounders at 40-50 MHz under WRC-23 Agenda Item 1.12;
- Advancement in the update of Recommendation ITU-R RS.1166 on active sensors, that had not been revised since 2009.
Spectrum Management Meetings (4/4)

- **Space Frequency Coordination Group (SFCG)**
  
  - FARS-TC succeeded to have the IEEE-GRSS RFI database linked at the SFCCG website
  
  - FARS-TC contributed two documents to the 2022 Annual Meeting (SFCG-41) and two documents to 2023 (SFCG-42), and responsible for several action items
CONFERENCES AND OUTREACH
FARS-TC organized two Invited Sessions at IGARSS 2022 and two Community Contributed Sessions at IGARSS 2023.
RFI 2022 Workshop

- FARS participated in the organization of a new edition of the RFI Workshop, held virtually on February 14-18, 2022, and hosted by ECMWF.
- The goal of the workshop was to promote the exchange of information and techniques on RFI.
- Remote sensing, astronomy and meteorological communities will share their strategies to mitigate RFI in their respective fields.
- 70 presentations and 9 posters: almost doubled last edition in 2019

http://www.rfi2022.org
FARS participated at the following conferences to discuss our activities or some of the FARS initiatives:

- ESA Living Planet Symposium
- CORF meetings
- ISRMM
- RWW/Sharc
- Radar 2021

FARS will also have a presence in the:

- URSI General Assembly 2023
FARS Online Tools

FREQUENCY ALLOCATION TABLE

GRSS FARS-TC tool available on the GRSS website at: [http://www.classic.grss-ieee.org/frequency_allocations.html](http://www.classic.grss-ieee.org/frequency_allocations.html)

- Added new country-specific allocations in the Frequency Allocations tool:

<table>
<thead>
<tr>
<th>USA Federal use</th>
<th>Europe (ECA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA non-Federal</td>
<td>United Arab Emirates</td>
</tr>
<tr>
<td>Australia</td>
<td>Belgium (BIPT)</td>
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<tr>
<td>China – Inland</td>
<td>Canada</td>
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<tr>
<td>China – Hong Kong</td>
<td>Colombia</td>
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<tr>
<td>China- Macao</td>
<td>India</td>
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<tr>
<td>United Kingdom</td>
<td>Brazil</td>
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<tr>
<td>Russia</td>
<td>Turkey</td>
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<tr>
<td>Egypt</td>
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</tbody>
</table>
The Space Frequency Coordination Group (SFCG) added a link to our FARS-TC RFI Observation tool on their website. It represents a recognition of the quality of the work performed by our Technical Committee. Currently including:

- SMOS
- SMAP
- Aquarius
- GMI
GRSM Magazine

The following articles were promoted by FARS in the Geoscience Remote Sensing Magazine:

• **December 2021 edition**: Agenda Items of the World Radiocommunication Conference 2023 With a Potential Impact on Microwave Remote Sensing,
  
  *by FARS-TC co-chair P. de Matthaeis*

• **December 2022 edition**: Protection of Earth Observation Satellites from Radio Frequency Interference: Policies and Practices, portraying the efforts to protect the spectrum,
  
  *by the Portuguese Autoridade Nacional de Comunicações*

• **December 2023 edition (planned)**: On the Chinese Lutan-1 Mission and RFI
  
  *by FARS-TC co-chair M. Tao.*

• **March 2024 edition (planned)**: On the PocketQube campaigns,
  
  *by UPC team*
GRSS Newsletter

FARS-TC actively contributed to the GRSS Newsletter:

GRSS contributes to new ITU recommendations

Use of the radio frequency spectrum by scientific and commercial services is managed by the International Telecommunication Union (ITU). IEEE GRSS has been participating in the ITU meetings to support the interests of the remote sensing community for several years.

In this framework, the FARS Technical Committee co-lead the development of two new recommendations on scattering from the sea surface to be used to predict interference from satellite transducers potentially reflected on the ocean into remote sensing instruments, such as that observed by GPIMG within the ITU R.151 (at 18 GHz):

- ITU-R P.2148: Sea surface bistatic scattering
- ITU-R P.2148: Digital maps related to surface wind speed statistics

An IEEE-GRSS product at the SFCG Website

The Space Frequency Coordination Group (SFCG), an organization comprised of space agencies and related national and international entities concerned with the use of the radio frequency spectrum for space-related application for the benefit of humanity, has recently included a link on its website to the Guidance of Radio Frequency Interference (RFI) observed by some remote sensing instruments on its section RFI to EESS (satellit) emissions. SFCG has the objective of coordinating the regulatory efforts of all such space agencies and related organizations to achieve an effective use and management of those radio frequency bands that are allocated to the ITU-Radio Regulations to the Space Research, Space Operations, Earth Observation Satellite, and Meteorological Satellite services.

By listing this database along with other important RFI repositories, SFCG is recognizing the quality of the work being done by the IEEE-GRSS Frequency Absorptions in Remote Sensing Technical Committee (FARS-TC).
Thank you for your attention!

For more information on the FARS Technical Committee visit: https://www.grss-ieee.org/

For any questions, please write to fars_chairs@grss-ieee.org.