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

Annual Meeting
Virtual
November 30, 2022
Content

• GUEST SPEAKER: J. Ciccorossi
  The need of reliable spectrum to ensure the success of your space mission

• FARS ANNUAL MEETING
  FARS Introduction
  Conferences and Outreach
  Spectrum Management
  On-going activities & initiatives

• 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

- Chair:
  Roger Oliva

- Co-chairs:
  Paolo de Matthaeis
  Ming-Liang Tao
  Tobias Bollian (stepping down)

- Secretary:
  Priscilla Mohammed
CONFERENCES AND OUTREACH
IGARSS

- FARS-TC organized two Invited Sessions at IGARSS 2022

- FARS-TC is organizing one Community Contributed session for IGARSS 2023
  - Associated presentations to this session not assigned yet.
  - Please send us an e-mail if you would like to present at the FARS-TC session: fars_chairs@grss-ieee.org
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-TC presence

FARS participated at the following conferences to discuss our activities or some of the FARS initiatives:

- ESA Living Planet Symposium
- CORF Spring and Fall meeting
- ISRMM
- URSI General Assembly
- RWW/Sharc
- Radar 2021
FARS-TC chapter in China

Academic & Industry Presentations

- 2021.11 Huawei Company (Xi’an, China)
- 2021.12 CIE Radar Conference (Haikou, China)
- 2022.03 Shanghai Academy of Spaceflight Technology (Shanghai, China)
- 2022.08 ICEICT Conference (Hefei, China)
- 2022.08 China National Space Administration (Beijing, China)

Research

- Joint research program “Interference Compatibility Analysis for X-band SAR Satellites” lead by China National Space Administration
- Joint research program “Interference Mitigation Strategy for Radar Remote Sensing”
**FARS Online Tools**

**FREQUENCY ALLOCATION TABLE**

GRSS FARS-TC tool available on the GRSS website at:


- Added new country-specific allocations in the Frequency Allocations tool.
- Currently in (new in blue):

<table>
<thead>
<tr>
<th>Region</th>
<th>Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA Federal use</td>
<td>Europe (ECA)</td>
</tr>
<tr>
<td>USA non-Federal</td>
<td>United Arab Emirates</td>
</tr>
<tr>
<td>Australia</td>
<td>Belgium (BIPT)</td>
</tr>
<tr>
<td>China – Inland</td>
<td>Canada</td>
</tr>
<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>
</tr>
<tr>
<td>Russia</td>
<td>Turkey</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
The following articles were promoted by FARS at the Geoscience Remote Sensing Magazine:

- **December 2021 edition (published):** 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 (submitted and approved):** 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,*

- **June 2023 edition (planned):** On the PocketQube,  
  *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 for 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-leads the development of two new recommendations on scattering from the ice surface to be used to predict interference from satellite transmissions potentially reflected on the ocean ice remote sensing instruments, such as that observed by GPIMISR at 18 GHz:

- ITU-P.214B: Sea surface bistatic scattering
- ITU-P.214C: 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 applications for the benefit of humanity, has recently included a link on its website to the "Statistical of Radio-Frequency Interference (RFI)" observed by some remote sensing instruments on its section "RFI & EMESS (passive) sections": 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 by the ITU (Radio Regulations of the Space Research, Space Operations, Earth Observation Services, and Meteorological Satellite services).

By listing the 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).
AI 1.16: Earth Stations in Motion (ESIM) near 18.6-18.8 GHz and Other Bands

AI 1.17: Inter-Satellite Links at 11.7-12.7, 18.1-18.6, 18.8-20.2 and 27.5-30 GHz

- Concerns for interference due to reflection off the Earth surface as well as from the direct path to the remote sensing sensor
- AMSR-2 and GMI operating at 18.6-18.8 GHz are already experiencing interference from reflections off the ocean surface of broadcast signals from geostationary satellites
- GRSS supports studies to ensure deployment at 17.7-18.6 GHz and 18.8-19.3 GHz will not increase adjacent band interference to EESS (passive) at 18.6-18.8 GHz band, taking into account surface water reflections from satellite downlinks
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.

- Special thanks to FARS Co-chair P. de Matthaieis, and FARS members: J. Johnson and M. Al-Khaldi
Spectrum Management Meetings (3/4)

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 SFCG website
  - FARS-TC contributed two documents to the 2022 Annual Meeting (SFCG-41):
    - Information document to introduce the development of a Standard to Quantify RFI in remote sensing bands.
    - Discussion document to initiate change on interference criteria for active systems with respect to coverage loss (RS. 1166).
## 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>
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<tbody>
<tr>
<td>1.2</td>
<td>International Mobile Telecommunications (IMT)</td>
<td>3.300-3.400 MHz</td>
<td>3.100-3.300 MHz (active)</td>
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<td></td>
<td></td>
<td>3.600-3.800 MHz</td>
<td>10.6-10.7 GHz (passive)</td>
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<td></td>
<td>6.425-7.075 MHz</td>
<td>10.75-12.250 MHz (passive)</td>
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<td></td>
<td>7.025-7.125 MHz</td>
<td>10.8-10.7 GHz (passive)</td>
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<td>10.0-10.5 GHz</td>
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<td>1.4</td>
<td>High-altitude platform stations as IMT base</td>
<td>various bands between 694 and 2090</td>
<td>2.690-2.700 MHz (passive)</td>
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<td></td>
<td>stations (HABS)</td>
<td>MHz</td>
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<td>1.12</td>
<td>Earth Exploration Satellite Service (EESS)</td>
<td>40.5-50 MHz</td>
<td>40-50 MHz (active)</td>
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<td>1.10</td>
<td>Non-safety aeronautical mobile service</td>
<td>15.4-15.7 GHz</td>
<td>22.21-22 GHz (passive)</td>
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<td>1.14</td>
<td>Earth Exploration Satellite Service (EESS)</td>
<td>231.5-232 GHz</td>
<td>235-238 MHz (passive)</td>
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<td></td>
<td>(passive)</td>
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<td>250-252 MHz (passive)</td>
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<td>1.15</td>
<td>Earth Station In Motion (ESIM) services</td>
<td>10.7-10.95 GHz</td>
<td>10.6-10.7 GHz (passive)</td>
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<td>13.25-13.75 GHz</td>
<td>13.25-13.75 GHz (active)</td>
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<td>17.2-17.3 GHz</td>
<td>17.2-17.3 GHz (active)</td>
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<td>1.16</td>
<td>Earth Station In Motion (ESIM) services for</td>
<td>17.7-18.6 GHz (space-to-Earth)</td>
<td>18.6-18.8 GHz (passive)</td>
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<td>Non GSO Fixed-Satellite Service (FSS)</td>
<td>18.8-19.3 GHz (space-to-Earth)</td>
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<td>19.7-20.2 GHz (space-to-Earth)</td>
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<td>27.5-29.1 GHz (Earth-to-space)</td>
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<td>29.5-30 GHz (Earth-to-space)</td>
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<td>1.17</td>
<td>Satellite-to-satellite links</td>
<td>11.7-12.7 GHz</td>
<td>18.6-18.8 GHz (passive)</td>
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<td>18.1-18.6 GHz</td>
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<td>1.18</td>
<td>Mobile-Satellite Service (mSSS)</td>
<td>1695-1710 MHz</td>
<td>3.100-3.300 MHz (active)</td>
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<td>2010-2025 MHz</td>
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<td>2300-2315 MHz</td>
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<td>3385-3400 MHz</td>
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<td>1.19</td>
<td>Fixed-Satellite Service (PSS) space-to-Earth</td>
<td>17.3-17.7 GHz</td>
<td>17.2-17.3 GHz (active)</td>
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<td>9.1 (b)</td>
<td>Amateur and Amateur-satellite services</td>
<td>1240-1300 MHz</td>
<td>1215-1240 MHz (active)</td>
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<td>1240-1300 MHz (FNSS)</td>
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<td>9.1 (d)</td>
<td>Non GSO FSS space stations</td>
<td>37.5-38 GHz</td>
<td>36-37 GHz (passive)</td>
</tr>
</tbody>
</table>
GRSS Views on WRC-23 Agenda Items

- WRC Agenda items with potential impact on the remote sensing Frequency bands.

- GRSS Views on the WRC-23 Agenda Items is nearing completion.
- We would like to have some volunteers to review it and provide their feedback. Please contact us directly. Another call will also be sent in a few days.
ON-GOING ACTIVITIES & OTHER INITIATIVES
POCKETQUBE (1/3)

- GRSS educational initiative proposed the development of an Open PocketQube Kit. It includes two PocketQubes (5cm x 5cm x 5cm):
  - Optical Payload.
  - RF Payload at L-band

- FARS discussed with Adriano and the IFT-TC and proposed the development of a 3rd PocketQube with RF monitoring capabilities at 24 GHz to follow the deployment of 5G and its impact on this remote sensing frequency band.
PocketQube:

- PocketQubes are well advanced, despite severe challenges: lack of components and/or rocketed prices have forced hardware revisions, delays, and budget overruns.
- Expected delivery by March 2023
- Initial Drone Campaign to assess performance to take place in Spain:
  - Goal is to have 5 flights in different areas and assess presence of RF signal at L-band and 24 GHz

- Preparation of a Second Drone campaign centered in areas where 5G transmissions at 24 GHz might have been deployed.

- Discussion started among FARS-TC chairs, A. Camps, and VPTA

- Investigating collaboration/interest with space agencies and/or international agencies
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 7 Working Group Meetings, and many sub-group meetings
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.