STARFIRE Algorithm

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Why in News?

Recently, Scientists at **Raman Research Institute (RRI)**, an autonomous institute of the **Department of Science and Technology** have developed an algorithm names **STARFIRE** to tackle unwanted **Radio Frequency Interference (RFI)** in space, enriching data obtained from space-based astronomy missions.

What is STARFIRE?

- **About:**
  - **Simulation of TerrestriAl Radio Frequency Interference in oRbits around Earth (STARFIRE)** is an advanced algorithm developed to **estimate and map unwanted RFI signals in space.**
    - The STARFIRE algorithm can estimate and identify the RFI emitted by various sources, **including FM radio stations, Wi-Fi networks, mobile towers, radar, satellites, and communication devices.**
  - This innovative algorithm has the potential to revolutionize space-based Astronomy missions and enrich the data obtained from such missions in the future.
  - To develop this algorithm, scientists utilized data on FM transmitter stations from six countries, including **Canada, the USA, Japan, Australia, Germany, and South Africa.**
- **Applications:**
  - **Enhancing Radio Astronomy:**
    - STARFIRE helps astronomers study the early Universe by estimating and mapping unwanted RFI signals in space.
    - It enables the tuning of radio antennas within the **40 to 200 Mega Hertz (MHz) range to detect the 21-cm hydrogen line**, revealing secrets about the cosmos.
  - **Optimal Instrument Design:**
    - The algorithm assists in **designing instruments for space-based Astronomy missions** that can operate optimally even in the presence of RFI.
    - This leads to improved data collection and analysis for future missions.
  - **Supporting PRATUSH Mission:**
    - STARFIRE is utilized in missions like **Probing ReionizATion of the Universe using Signal from Hydrogen (PRATUSH),** aimed at studying the **birth of stars and galaxies in the Universe** using the 21-cm hydrogen line from the far side of the moon.
    - The algorithm plays a key role in **fine-tuning antennas** and instrument components for successful data gathering.
  - **Orbit Selection:**
    - The algorithm's capability extends to aiding **orbit selection for future space missions.**
    - It identifies **low RFI orbits, particularly in the ~100 MHz frequency range, making them suitable for various scientific experiments.**
  - **Flexibility and Versatility:**
    - STARFIRE offers flexibility to **adjust the properties of transmitting and receiving antennas.**

        - This enables including astrophysical radio signals from our own galaxy and the cosmos, leading to more meaningful experimental results.
    - **Potential for Wide Range of Applications:**
        - The generic mathematical formulation of the STARFIRE code makes it adaptable for various applications, benefiting missions with low RFI orbits.

Radio Frequency Interference (RFI):

- RFI is a type of **electromagnetic interference (EMI)** that affects **devices or circuits that operate with radio frequencies.**
- RFI in space can affect the **quality and reliability of satellite communications, navigation, and remote sensing systems.**
- RFI can also interfere with the scientific observations and measurements of space-based instruments, such as radio telescopes and radars.