



## **Remote Sensing and In situ Space Science Exploration Programme in ISRO**

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With a legacy of six decades, Indian Space Research Organisation (ISRO), has evolved through various phases. During its initial phase in 1960-70s, the space programme witnessed germination of the vision and mission of the space agency through sounding rocket experiments to study the Earth's atmosphere and ionosphere. The experimental phase began in 1980s, during which experimental missions were sent to space and end-to-end capabilities were built-up. Remote sensing techniques played an important role in those endeavours. It was followed by operational phase in 1990s that witnessed several operational missions and contribution to nation-building, which was followed by the expansion phase in the new millennium, with expansion of the scopes of scientific, applications, technology-demonstrator missions. Remote sensing techniques have played significant roles in all these endeavours, may it be for Earth Observation, Planetary Exploration or Astronomy / Astrophysics.

The scientific exploration of ISRO that started with sounding rocket experiments in 1960s, evolved to the stage of sending stand-alone scientific payloads in 1990s, which subsequently evolved to sending full-fledged space exploration missions to study the solar system and beyond. Since 2008, ISRO has sent Chandrayaan-1 mission, Mars Orbiter Mission, AstroSat mission and Chandrayaan-2 mission, while a series of space exploration missions are in pipeline.

Throughout the process of its evolution, ISRO has contributed to scientific exploration of the Earth, the Sun and the solar system, as well as study of the astronomical sources, through remote sensing techniques. Remote sensing techniques have been applied at different parts of the electromagnetic spectrum; like infra-red remote sensing for studying the hydration and mineralogy signatures on planetary surfaces, X-Ray Fluorescence (XRF) remote sensing for surface elemental composition, to name a few. The remote sensing techniques have been complemented by in-situ observations as well. Often, the in-situ observations of entities have some story to tell about the sources thereof. As for example, the in situ observation of the neutrals in the lunar exosphere provide insight to the processes at the lunar surface and interior. These techniques have been extensively used in ISRO's space exploration missions.

This lecture will present a brief overview of the major themes of space science exploration by ISRO, its space science missions and observation techniques, along with a few science results.