

Center for Space Research

Introduction

CSR is a scientific center specialized in the development of space tele-communication and radio frequency products, space science, explorations, remote sensing and ICT.

Description

CSR Origins and missions:

Center for Space Research (CSR) established by the Iranian Space Research Center (ISRC) is a space technology and application development institute. Since 2011, CSR has harnessed satellite communication and remote sensing technologies for national development. In addition to space research, CSR has broadened its projects in the fields of remote sensing, communication systems, weather surveillance radar, radiosonde, radio telescope, IoT, etc. CSR's staff, includes more than 50 experts and engineers in the fields of electronics, telecommunication, software and remote sensing which are conducting various research in two departments of remote sensing and telecommunication. This group provides expert engineering support for all project phases including design, develop, integrate and test. Many projects on precision farming and water resource management are conducted in CSR's remote sensing department. Capabilities and facilities on designing RF circuits, microwave passive and active circuits and antennas are provided in the telecommunication department. Impressive participation in the development of communication links and relays of the ISRC's satellite Nahid 1 as a pioneer space sub-system developer in Iran, is one of the successful recent projects.

CSR projects and achievements:

Some accomplished and in progress projects of the CSR are as follows:

1. Remote Sensing

Considering the population increase, successive draughts and water resource shortage in the country, the issues associated with agriculture development and water consumption are of paramount importance in Iran. Accordingly, the CSR's department of remote sensing concentrates on topics aiming to develop and preserve food security and water resources. This department has already been involved in several farming projects. A few of the main projects in this department include: 1- Developing models and spectral indices based on time series of satellite imagery to perform automatic crop area mapping; 2- Developing models to estimate parameters related to crop health and status such as biomass, yield, leaf area index (LAI) and chlorophyll; 3- Wheat disease (Rust and Fusarium) detection and prediction using satellite and airborne imagery. The department is currently conducting projects on monitoring of agricultural situation in the west and south of the country. Regarding the importance and priority of agricultural products and water consumption efficiency in Iran, the department of remote sensing has a perspective on using high resolution imagery in order to develop future research activities on precision agriculture. In this regard, the research groups are going to benefit from an advanced airborne hyperspectral camera. This mission could be helpful for various agricultural purposes, such as crop mapping, crop disease detection, etc. Water resources and rights management is also one of the current research areas in the remote sensing department.

2. Space Telecommunication System

Satellite communications play a vital role in the global telecommunications system. A telecom satellite, receives signals from an Earth station and amplifies the signal and retransmits it back to ground station. The subsystem which performs the functions of both transmitter and receiver in a satellite is known as Transponder. The transponder of the satellite includes the receiving antenna, a broad band receiver, an input multiplexer, and a frequency converter which is used to reroute the received signals through a high-powered amplifier for downlink.

CSR provides the design and development of transponders, subsystems and payloads for satellite communications. Some of the projects implemented in this research area are as follows:

design, manufacture and test of the engineering and qualitative models of X-Ku band telecommunication links for Nahid-I satellite system

design, manufacture and test of the UHF band communications link for upper stage systems

design, manufacture and test of the Ku band transponder

design, manufacture and test of the ground stations

design and manufacture of X-Ku & S band tracking system for Nahid-I satellite system

design, manufacture and test of the engineering and qualitative models of X-Ku band telecommunication links for Nahid-II satellite system

3. Space Exploration

Space exploration is the discovery and exploration of celestial structures in outer space by means of evolving and growing space technology.

Orbital Telescope: An Orbital telescope or Space Telescope is an instrument located in outer space to observe distant planets, galaxies and other astronomical objects. Orbital telescopes avoid many of the problems of ground-based observatories, such as light pollution and distortion of electromagnetic radiation. The project is in its early stages. The feasibility and Needs assessment study of this project was carried out.

Radio Telescope: A radio telescope is a specialized antenna and radio receiver used to receive radio waves from astronomical radio sources in the sky in radio astronomy. They may be used singly or linked together in an array. Unlike optical telescopes, radio telescopes can be used in the daytime as well as at night. Since astronomical radio sources are very far away, the radio waves coming from them are extremely weak, so radio telescopes require very large antennas to collect enough radio energy to study them, and extremely sensitive receiving equipment. In this project, locating, system design, antenna design and many activities were done.

4. Weather Radars

Weather radar has an important role on meteorological assessments. Radar is an essential sensor which can provide real time and accurate information on hazardous weather phenomena such as strong wind, heavy precipitation and hail in large scale area.

Modern weather radars are mostly pulse-Doppler radars, capable of detecting the motion of rain droplets and type of scatterers in addition to the intensity of the precipitation. Both types of data can be analyzed to determine the structure of storms and their potential to cause severe weather.

The subsystems designed in CSR for this project includes: "Civil structure and robust mast to withstand 220 km / h wind", "Transparent radome design against electromagnetic waves in dual polarization", "Antenna and waveguide design", "Solid state high power amplifier up to 3kW", "Ultra low phase noise synthesizer", "Digital system and boards, processing pulse compressed signals", "software package providing radar management and meteorological product generation ", "High-tech algorithms, processing the received signals", "A robust and reliable pedestal with two azimuth and elevation continuous motions", "Pedestal controlling with high precision and the lowest clearances", "Managing the compliance interfaces between various parts".

5. Radiosonde

Radiosonde is a telemetry instrument used to measure meteorological variables in the atmosphere such as: altitude, pressure, temperature, relative humidity, wind speed and wind direction. The World Meteorological Organization's (WMO) Global Observing System (GOS) network releases more than 1,500 radiosondes every day. The radiosonde, is lifted to the upper atmosphere to altitudes of 10 to 40 km by a weather balloon filled with helium or hydrogen. The measured data are essential for high accuracy weather forecasting and are used by meteorological institutes worldwide. Radio sounding data are also used by climatologists, universities, research groups, environmental agencies and defense services for a variety of purposes.

CSR started to develop and design its own sounding system in 2016. This system contains 4 sub-systems: Radiosonde, Receiver, Antenna and Software.