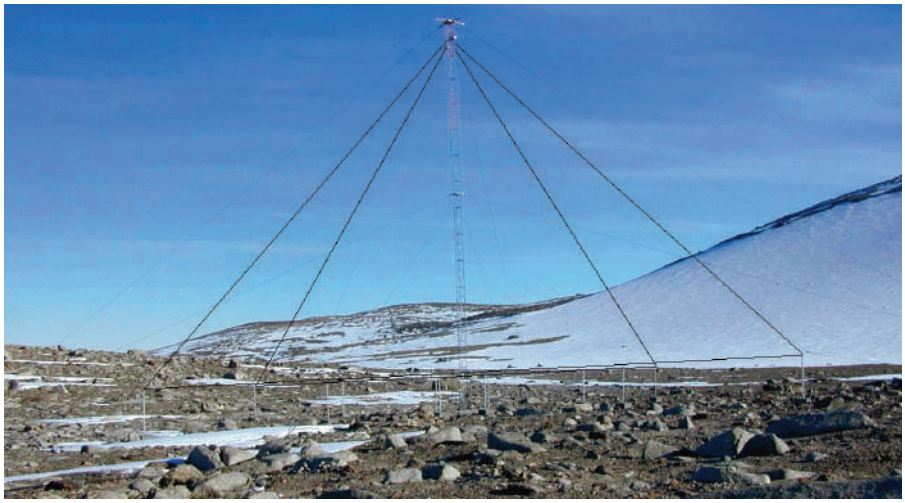
AIS-INGV Advanced Ionosphere Sounder for Space Weather and communication applications

Was a new patent for an HF radar necessary?

Since its establishment the Istituto Nazionale di Geofisica e Vulcanologia (INGV) has been deeply involved in ionospheric studies and monitoring. One of the basic instruments for carrying out these studies is the ionosonde, an HF radar for detecting the height, critical frequencies, electron density and other parameters of ionospheric layers. Even though such radars already exist, INGV wanted to develop and build its own ionosonde to have a flexible and reliable instrument for research purposes. **The result is the Italian patent for a digital ionosonde n°00013255371**. The patent is managed by SpacEarth Technology, the INGV spin-off.

SpacEarth branded AIS-INGV ionosonde in a portable configuration complete with power amplifier and control PC.



Transmitting and receiving antennas arranged on a single mast (Antarctica).

All the space-related INGV flyers are here!

AIS-INGV is integrated with Autoscala, a software for real time estimation of ionospheric parameters. Modern tools for data management, interoperability and elaboration are part of the system. Outputs follow the international standards defined by scientific and technological communities (e.g. URSI, IRI, IAGA, COSPAR). AIS-INGV models are currently working in ionospheric observatories in several continents.

COS CENTRO OSSERVAZIONI SPAZIALI DELLA TERRA

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graphic design Laboratorio Grafica e Immagini | INGV

AIS MAIN FEATURES

- Pulsed radar for vertical ionospheric sounding
- Fully configurable by PC
- Frequency scan or single frequency mode
- Frequency range 1 - 20 MHz
- Scan duration 3 min (typ.)
- Transmitted power: 250 W peak
- Triple conversion receiver with I-Q detection
- Height range: 90 - 760 km
- Height resolution: 5 km
- Complementary bi-phase pulse encoding
- Coherent Pulse integration
- Graphics data output (ionogram)
- Numerical output compatible with scientific network and DB infrastructure.

AUTOSCALA SOFTWARE

- Drawing of the electron density profile
- Real time estimate of ionospheric parameters:
- foF2, MUF(3000)F2, M(3000)F2, foF1, h'Es,
- and others
- Data spreading to the web
- Web interface

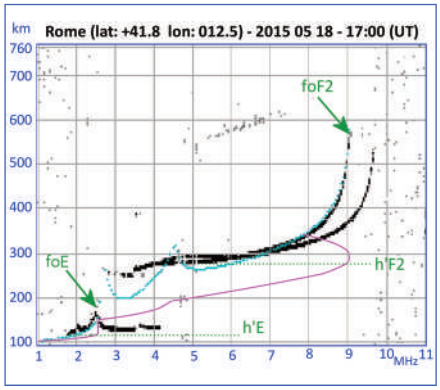
Once an ionogram is obtained Autoscala software analyzes it to obtain critical frequencies and virtual heights.
Ionospheric parameters are necessary to calculate the density profile which is the electron distribution along the height.
Scaling of the ionogram takes no more than 2 minutes making AIS-INGV a useful tool for real time monitoring of the terrestrial ionosphere.

ANTENNA FEATURES

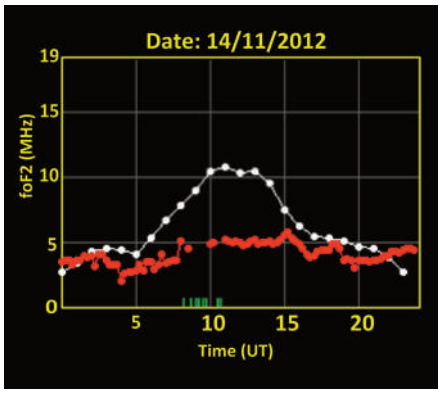
Antennas for the vertical ionospheric sounding are a crucial element in the general design.
The main characteristics valid for both TX and RX antennas are:

- a wide band to be matched in a wide frequency range;
- the main radiation lobe directed upwards;
- a good gain to overcome the ionospheric attenuation and the geometrical loss.

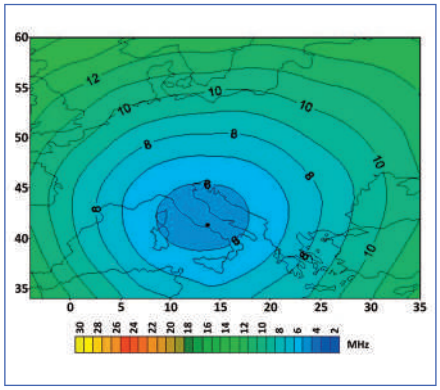
Rhombic or delta antennas are good solutions for ionospheric sounding. Specifically, delta antennas have a good gain and the proper bandwidth. Their simple design makes them ideal to be used with an ionosonde: in the picture TX and RX delta antennas are cross- configured on a single mast.



Sample of a real-time scaled ionogram, which has a direct application in forecasting by Space Weather monitoring centres.



One day measurements of foF2 parameter. AIS-INGV ionosonde is a valid tool for monitoring and alert for ionospheric storms.



Forecasting of HF communication conditions over the Italian regional area. AIS-INGV ionosonde is a valid tool for the sector using radio-link as maritime, aviation, defense, and civil protection.

Since the first specimens for internal use, AIS-INGV has proved to be a reliable and flexible product, such that it is now considered a valid solution for vertical ionospheric soundings by other ionospheric research institutes. Industrialization and marketing is carried out by SpacEarth Technology, a spin-off company of Istituto Nazionale di Geofisica e Vulcanologia, comprising a team of researchers, engineers, physicists, and geologists delivering executive solutions in Seismology, Environmental Geophysics, Remote Sensing, Satellite Navigation and Positioning and Training fields.

Our goal is to realize innovative products and services thanks to knowledge and technological transfer from excellence in research.

INGV spin-off
SPACEARTH TECHNOLOGY