

A System With Large Application Abilities

Any precious work, created by Armenian people, increases the rating of our country for one more level, particularly, when it acquires an international significance.

The system developed by a famous scientist Artashes Arakelyan and his research team, is a unique one all over the World with its possibilities of solving global problems, and it can provide our country with an opportunity of getting obvious advantages and great profits.



I mean a spatio-temporally combined, single or multi-frequency, multi-polarization, microwave radar-radiometer systems for the Earth surface (sea and land) and atmospheric (boundary layer) remote sensing.

According to the rating of international scientific community, this radio engineering system, unique throughout the world with its abilities and measuring methods, may be used with the purpose of carrying out a thorough investigation of the environment and its effective management.

At present, when the progress of information technologies is considered to be a supreme direction in the development of economics in Armenia, it will also be possible to come to the world's view with this scientific result, supporting thus the best use of the Armenian scientific idea. The application of technologies for solving global problems of regional and local importance by measuring microwave characteristics of the Earth surface can really provide a big profit for the state. Developed devices and their application are quite expensive, though super-precise and economically grounded. Moreover, the fact of being expensive is also relative: if those expenses are taken for the sake of the territory's economics, of solving main nature-protecting problems, then only 15 cents will be spent for 1 acre area land with these methods. The use of science in economics is sometimes an expensive pleasure, but its final result can cover all expenses in the course of time. It's simply

necessary to give correct orientation to that invention, due to its demand.

The history of the system's development

Artashes Arakelyan: doctor of physical-mathematical sciences, senior researcher of the Institute of Radiophysics and Electronics of National Academy of Sciences of Armenia, professor of the Department of Radiophysics of Yerevan State University, member of the international organization IEEE/GRSS (the Institute of Electrical and Electronics Engineers/Geoscience and Remote Sensing Society). He deals with research of the earth surface with radio-physical methods, carries out theoretical and experimental activities, concerning that field. He has 33 years of working experience, more than 150 scientific articles and other publications. Scientific methods and radar systems, offered by him, are secured with 18 author certificates and patents (national and international). The scientist worked in the sphere of weapon industry since 1988 that is why his scientific results were closed, consequently, unfamiliar to international public.

In 1988-2002, even in the new created conditions in Armenia, the scientist went on working, displaying great efforts, and without anyone's support, keeping faithful to his dream and advanced ideas. After 1995, being fluent in two foreign languages – English and French, he



got the possibility to present his investigations in front of the international public as well. Investing the last savings of the family, he took part in many international meetings and conferences. He presented the theoretical results he had received, and he could gather a group of collaborators.

“Before the development of the first device, when I said, that I have got such ideas, patents, no one believed me, they laughed at me”, recalls the scientist. “Here is what attracted the international researches and organizations in my works, and they expressed their wish for cooperation: we could carry out radar measurements at a very short distance, under test-control laboratory conditions, we could study relationships between microwave and geophysical and biochemical characteristics of soil and snow, water surface and atmospheric boundary layer”.

Dr. Artashes Arakelyan was believed, supported, and provided with a great amount of grants for Armenia: 6 grants - within the years of 2002-2008 (the National Foundation of Science and Advanced Technologies (NFSAT), the US Civilian Research and Development Foundation (CRDF), the International Science and Technology Center (ISTC)). In the framework of these awards the Company ECOSERV Remote Observation Centre LLC (ECOSERV ROC), established by Dr. Arakelyan in 1997, has commenced its activities in scientific



From left to right: Marine Simonyan, Vanik Karyan and Melanya Grigoryan.

developments. The research team of former weapon and experienced scientists in this field managed to turn the idea into a reality.

Peculiarities of the system

A single or multi-frequency, multi-polarization, combined radar-radiometer system has been developed in Armenia and there is no such a technology all over the world. It allows to measure microwave reflective and emissive characteristics of the observed surfaces simultaneously at two frequencies and four polarizations and to study and control conditions of various environmental surfaces and media (soil moisture, water temperature and salinity, air temperature, snow moisture and melting time, etc.), to record and distinguish available changes of the Environment.



ECOSERV ROC Company's Experimental Site, for measurements of soil, snow, vegetation and water surface microwave reflective and emissive characteristics angular dependences under test-control, quasi-field conditions

The system is handy for being used and allows carrying out measurements from very short distance. The minimum operational range of the system's radar is 5m. The advantages of the developed devices, as well as of those, having been developed by him, is their function in 7 various frequency bands, from 1GHz up to 37GHz, their ability to carry out polarimetric measurements at vertical, horizontal and cross polarizations. The systems advantages are combining of radar and radiometric methods. They allow simultaneously measuring at least 32 microwave characteristics of the observed surface. Available systems in the World allow measuring no more than 2-3 characteristics of the surface.

Not only were the devices developed. Also an experimental site “the Measuring Polygon” was built and equipped with measuring platforms and combined radar-radiometer systems, operating at 7 frequencies, as well as with facilities for absolute calibration.

The devices are set on the mobile buggy, moved along a quarter circle shaped measuring platform of a radius of 7m. The experimental site provides a possibility to carry out angular measurements of microwave characteristics of the same area of snow, soil, ice, and water surface, using more applicable frequencies for the observed surface. The results, expected to be obtained from multi-frequency and multi-polarization measurements carried out in the experimental site, will provide researchers of this field with an opportunity to improve the existed reflective and emissive transfer models for various surfaces and to increase accuracy of processing of radio images obtained from the space. The existence of the systems is met with the surprise of the foreign specialists, working in this field of researches, particularly in the sense, that such values have been developed and built in such a small country.

Possibilities of the system's application

The system may be used for both scientific and control-management researches. The results obtained by the system may be used for precise and unambiguous estimations of the main geophysical and biochemical characteristics of the observed surfaces.

Large application possibilities of the system are in oceanography, in agriculture and forestry, in hydrology and irrigation, in water resources' management and environmental

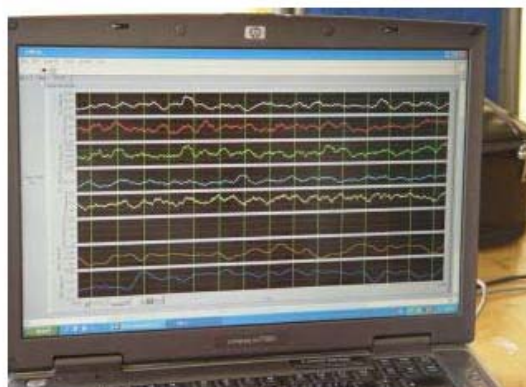
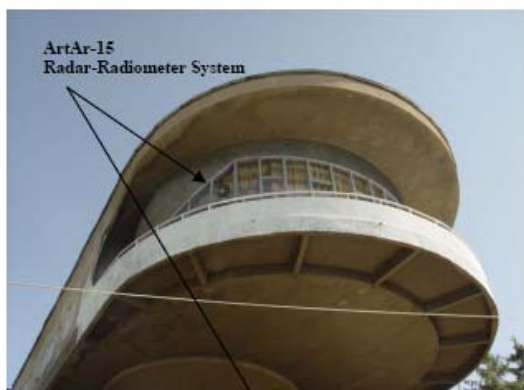
security, in protection of the nature, in meteorology and weather forecasting industry, etc. We'll explain that in details using 1-2 examples.

The problem of detection of underground water reservoirs under a depth of 60-100 m in arid and semiarid regions and assessment of water quality may be solved by radiophysical methods and means of sensing. The results obtained by these systems will help farmers, dealing with large areas, to control and to manage soil condition, soil moisture, the harvest quality, consequently, to optimize the harvest amount, and so on and so forth.

Particularly for Armenia, it's possible to realize the following processes by application of these systems:

1) To solve two problems, connected with Lake Sevan: to carry out a regular monitoring of the coastal waters of Lake Sevan, which is necessary to preserve the largest reservoir of fresh water in the Southern Caucasus, and to struggle quite effectively against poachers (the territory of the Sevan isn't so large: it's possible to record the real image of the whole territory, by means of a flying laboratory).

2) Forestry may get information about the whole territory within a single day, and compare the results of in-situ (local) observations with the results of airborne measurements. So, the problems of forests' cutting, fire prediction and prevention, mapping of forests will be solved thus, the real state of the forest will be recorded, as well as the dryness degree of the forest.



Lake Sevan, Experiment

3) Precise details may be recorded about emission of various kinds of pollution. It's applicable for control and management of nuclear and thermal power stations, mines and chemical industries.

4) By means of meteorological measurements, a number of losses will be prevented there, if precisely to estimate cloud's parameters.

5) The state of the earth surface may be evaluated – geodesy, the state of the soil, its structure, etc.

Educational and training activities

ECOSERV ROC Ltd. provides its all scientific and experimental potential including laboratories, developed microwave devices and the experimental site with measuring facilities to undergraduate (bachelor) and graduate (masters degree) students of the Radiophysics Faculty of Yerevan State University for their practical courses in R&D.

Certainly there are lots of higher education institutions which are prominent for having modern equipment, but opportunities provided by ECOSERV ROC (measuring facilities, platforms and microwave devices) are globally unique.

While Bachelor's 4th and Master's 1st year students attend ECOSERV ROC's laboratories with purpose of gaining practical knowledge, they are getting acquainted with the process of development of new kind of microwave devices and their application opportunities. Many students graduating from the Faculty of Radiophysics do their first scientific experiments and researches in these laboratories and the experimental site and use



PhD Students: Melanya Grigoryan and Maryam Krdyan.

obtained field-work results for their Final Papers. Some of these students get employed by ECOSERV ROC as young scientists and continue their research in fundamental and applied science for getting certified as candidates of sciences (Ph.D.).

ECOSERV ROC's R&D potential can be source of large scale opportunities for young scientists for theoretical, experimental and engineering works in the field of the Earth surface and atmosphere microwave remote sensing, which is currently one of the leading and prospective field of the World Science.

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