Antenna Centre of Excellence

ACE network for excellence in all European antenna research activity

ACE is a pan-European Network of Excellence aiming to structure the antenna research activities in all European R&D groups dealing with the electromagnetic radiation and the signal properties of antennas. ACE includes actors from large companies, SMEs, research institutes, governmental agencies and universities and is creating a sustainable networking activity at the level of antenna software and measurement facilities, European postgrade education and European conferences

Antennas are a key constituent of all terrestrial, airborne and space based wireless communications and sensor systems. Antenna functions are fast evolving, driven by the demanding needs of the Information Society Technologies. Traditional antenna areas still demand research and innovation efforts, but new, unforeseen and challenging problems are also appearing.

Antennas and electromagnetic sensors are also becoming a major system component in areas such as consumer electronics, health care, biology, radio astronomy, Earth sciences, and Earth resources monitoring.

To obtain a deeper understanding of antenna operation in these new and complex environments and to develop adequate modelling and measuring tools are tasks that need a deep knowledge of the European antenna landscape. The European Network ACE, with its 51 partner institutions belonging to 17 European countries and issued from very diverse horizons, is the ideal instrument for performing such a task.

ACE deals with the antenna function of radio systems which happens at the "air interface" between the electronic circuits signals and the electromagnetic radiated waves. Keystone items are the beam-forming functions and the adaptive "smart" systems to provide reconfigurability and to optimise performance. In these key areas the network is structuring the fragmented European activity, increasing researcher mobility, reducing duplications and boosting excellence and competitiveness.

Objectives and implementation

The main purpose of ACE is to increase the efficiency and relevance of antenna research in Europe. It aims to increase the innovation level by a more efficient flow of ideas. Due to its huge size, ACE has requested a careful implementation and a matricial structure has been selected.

On one side, vertical activities highlight specific research areas where the need for coordination and structuration at the European level is most obvious. These activities result in joint-research programmes, usually dedicated to frontier or pioneer topics, where researchers and facilities are put together and careful planning is made to avoid overlapping. A careful preliminary investigation of the European research landscape has shown a number of application-oriented research areas that should be restructured. While the ACE emphasis is on enabling technologies, its strong industrial partnership guarantees that the application and system aspects are given heavy weight to make the research relevant.

Crossing these vertical activities, there are also series of horizontal activities, where all the antenna R&D topics are put together and viewed from the standpoint of Coordination, Integration and Spreading, aiming to reach additional European synergy effects.

A "wireless coordination" activity gathers the required information from industry and end-users. This way, the long-term relevance of the research is assured and future needs within the different application areas can be established.

Integration activities aim to structure existing knowledge from different application areas, thereby avoiding both fragmentation and duplication. Main efforts are dedicated to antenna softwares and to measurement techniques.

Spreading Activities include education and dissemination activities, crossing the whole set of vertical activities. The goal is to integrate the higher level education on antennas in Europe, to link with professional and national antenna societies and to make dissemination more efficient by organising large European conferences.

A group of outstanding international experts outside ACE (The Scientific Council) helps to define the strategy of the network and to select the achievements that should be sustained in the future.

The Virtual Centre of Excellence

At the heart of ACE, a virtual centre of excellence (VCE, (http://www.antennasvce.org), acts as both a knowledge base and a communications and dissemination centre. It contains educational material, useful links and technical reports and databases from the Networks activities. The VCE allows internal exchange of knowledge on a private basis available for the ACE members, but also an external spreading of knowledge, thanks to a public section open to the scientific community.

Free ACE Community membership is available. Currently, more than 300 institutions are members of the Community. The VCE should become in the future the self-sustainable centre of the European antenna community, thus providing a durable success for the ACE Network.

An unusual extra-light miniaturized antenna mounted on a biogradable support for animal tracking and tagging

Vertical activities

Vertical subjects cover the new and challenging antenna technologies

Integrated antennas at mm and sub-mm wave frequencies

The future wireless systems will call inexorably for higher and higher frequencies, allowing increased channel capacity and on-chip miniaturisation. Only at these frequencies could be the antennas be fully combined with micro and nanosystems. ACE has provided a pioneering and thoroughly study of the "Challenges in Terahertz Antennas" and has established a strong collaboration with another network of Excellence "AMICON" (www.amicon.info) to integrate antennas with RF MEMS and microsystems.

Small antennas

Miniaturisation is one of the main challenges in antenna technology both for ubiquitous wireless functions and for biological applications. Hence, this activity coordinates the European research on antennas for mobile and wireless terminals including new topics such as RFID tag systems, EM radiation dosimetry or bio-medical applications. In addition, the next generation of wireless terminals with new strategies like MIMO (Multiple-Input Multiple-Output) or UWB (Ultra-Wideband) call for new functionalities in antennas that must remain small.

Wideband and multiband antennas

The activity aims at structuring and advancing the European research on multiband and wideband radiators, needed for advanced communications and for key applications like surface probing and ground penetrating radars (GPR).

This includes remote sensing in sensitive areas, resource monitoring, catastrophe warning systems and medical imaging. In addition to this, new strategies for surface modelling of conventional reflector antennas and efforts in characterisation of new materials for antennas are being coordinated.

Planar and conformal arrays

These antenna arrays are essential in mobile communications, including satellites, planes and cars. This activity aims at networking the European research in the field of planar and conformal arrays, in order to identify the bottlenecks and help to overcome them by a joint efforts. The ACE Network is coordinating European research on the optimisation of array antenna architectures, especially for large structures conformed on non-planar surfaces.

Smart Antenna Systems

Smart Antennas are the key components of sophisticated wireless sensor networks, and reconfigurable and flexible systems able to re-shape the antenna beam and hence its electromagnetic radiation density. Smart antennas is a multidisciplinary area combining electromagnetics, signal processing, channel propagation, optimisation theory and statistics. Therefore, in this activity integration and dissemination activities are essential. They aim at defining a common framework both in the theoretical analysis, simulation methodology and sharing of common tools.

For details of ACE Antenna's Horizontal activities please see following page.

Horizontal activities

Coordination with wireless applications

The relevance of ACE research for wireless applications is ensured by a strong industry representation in ACE and specifically by the participants in this activity. The work includes assembly of information about future needs from interviews with industry and users and by studying relevant literature. participants in this activity. The work includes assembly of information about future needs from interviews with industry and users and by studying relevant literature.

The Antenna Software Initiative

One task of the Network ACE is to survey the antenna software tools available within Europe. This has resulted in a catalogue describing the most relevant software tools. This inventory provided sufficient details to define a standard benchmarking procedure which allows to ascertain the quality of a given tool. The next step, now under way, is to consider how to boost the capabilities of the tools by creating synergies among the existing and running software codes, thus restructuring the European effort in this key area.

Antenna Measurement Techniques

Here, the main developments concern the integration of the European antenna measurement expertise, the standardisation of antenna measurement techniques and the development of new measurement techniques for emerging antenna technologies. The activity is establishing a great cooperation between existing European teams. This includes not only sharing of equipment and expertise, but also a high degree of mobility among the partners. Joint operation of advanced antenna measurement facilities is under way and should contribute to a European re-structuring of the R&D practice in antenna measurements.

Training and education

In the training and education, the main achievement of the network has been the European School of Antennas (ESoA), which is a new model of a geographically distributed PhD and continuing education school aiming to improve the antenna advanced training and education in Europe. The school is constituted by a highly-qualified and integrated set of advanced courses, distributed in the most accredited European research centres on antennas. These courses contribute to European excellence and are useful for completing PhD curricula in electrical and computer engineering, through agreements reached with the European universities. At the same time, they provide continuing education for R&D professionals working in Industries or elsewhere.

Dissemination and Knowledge Transfer Management

A great deal of dissemination is achieved through the Virtual Centre of Excellence (VCE). Other Dissemination activities are concerned with Intellectual Property (e.g. short courses on patents), with societal aspects (general public perception of antennas, campaigns for attracting young people) and with SMEs (constitution of databases increasing their visibility and facilitating the exchange of information and transfer of knowledge).

The main achievement in this activity has been the creation in Brussels of the Association EurAAP (European Association in Antennas and Propagation). EurAAP will be steered in the future by a International Constitutive Board, including European personalities and members of the main professional national Antenna societies. EurAAP should provide a harmonious framework for cooperation. Currently, EurAAP has created the European Conference on Antennas and Propagation (EuCAP) with a very successful first edition in Nice, France (www.eucap2006.org). A second edition is scheduled in Edinburgh on November2007 (www.eucap2007.org) and a third edition is planned in Germany.

At a glance: ACE

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