An overview of European cooperation on antenna research

M. Martínez-Vázquez
IMST GmbH

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Wireless systems of tomorrow

Cost-efficient
Reconfigurable
Frequency agile
Adaptive
Multifunctional

MIMO
Cognitive Radio
Wireless Sensor
Networks

Satellite
Communications
THz Imaging &
Radar
Antennas: an «interfacing» activity in COST

Antennas:

The tyres !!

RF-Electronics:

The engine

Channel propagation, Navigation systems, Global Integrated Networks, Atmosphere; Meteorology

The track

VISTAv
Versatile, Integrated, and Signal-aware Technologies for Antennas
Why so important?

Present day (information) technology

The wireless interface

TOP ANTENNAS

The winning team

Effect (the application)
Antennas are the « tyres » of ICT Actions

We should never ignore them!
Translated to antennas:

Antennagate!!!
European Antenna Research

**Targets:**
- Research, but also
- Networking
- Educational and Societal aspects
- EU strategic aspects

**Instruments:**
- Networks of Excellence, Coordinating Actions, Marie Curie initiatives, Training Networks, European Schools, “COST” projects...
What is COST?

Founded in 1971, COST is an intergovernmental framework for European Cooperation in the field of Scientific and Technical Research. COST Actions cover basic and pre-competitive research as well as activities of public utility.

COST has been successfully used to maximise European synergy and it is a useful tool to further enhance European integration.
COST main characteristics

- “Bottom-up” – no fixed programmes / priorities
- Flexible participation – join in if you are interested
- Focus on multidisciplinary cooperation
- Enabling agent – Promotion of Early Stage careers in Research
- Open to global cooperation in the mutual interest
- “Non-competitive” – pre-normative; public utility
- Networks based on national funding of researchers and projects – national responsibility
Timeline: Antenna COST Actions

1973-1977 - COST 25-1: Aerial network with phase control
1980-1984 - COST 204: Phased array antennas and their novel applications
8 countries
1984-1988 - COST 213: Electronically steered antennas for future
satellite and terrestrial communications in the 90s
12 countries
1993-1997 - COST 245 Active arrays and array fed reflector antennas
17 countries
18 countries
2002-2006 -COST 284: Innovative Antennas for Emerging Terrestrial and Space-based Applications
20 countries
2007-2011 - COST IC0603 ASSIST: Antenna Systems & Sensors for Information Society Technologies
27+2 countries
The ACE Network (2003-2007)

The final answer to existing problems

- No real European antenna community
- Week cooperation industry – university
- Research not always relevant
- Little cooperation in PhD education
- Little reuse of software and test facilities
- Too much duplication
- Weak dissemination
ACE outcomes

• European Association on Antennas & Propagation (EURAAP)
• EUCAP Conference (5th edition next year)
• European School of Antennas
• Benchmarking and standardisation activities (software/measurement)
• Follow-up FP7 coordinating actions: Antenna Research & Technology for the Intelligent Car (ARTIC), Coordinating Antenna Research in Europe (CARE)
European school of Antennas (ESoA)

- Geographically distributed post graduate school
- Founded in 2004 by ACE
- Objective: reinforce European training and research in antennas and relevant applications.
- Presently financed by a Marie Curie Action (MCA) project.
- Courses are distributed in the most accredited European research centres on antennas and wireless systems.
COST IC1102 „VISTA“

- Versatile, Integrated and Signal-aware Technologies for Antenna
- COST domain: Information and Communication Technologies
- Duration: 2011-2015
- Website: [www.cost-ic1102.eu](http://www.cost-ic1102.eu), [www.cost-vista.eu](http://www.cost-vista.eu)
Trends...

**Theory:** Antennas as *physical layer*:
physics (electromagnetics) & technology (materials science).

**Practice:** Antenna systems spread into many layers!!!
New challenges call for new paradigms

Demand for more and better ICT services explodes

Increased use of energy and spectrum limited resources!

Solution: signal-antenna joint techniques for lower energy and spectrum usage

- **MIMO**: multi-radio in small devices
- **Cognitive radio**: opportunistic frequency/coding
- **WSN**: distributed cooperative communication
Old and new challenges, new solutions

Satellite communications
- Higher frequency (Ka-band) for higher data rates
- Reconfigurability: adapt the coverage/extend lifespan
- Receivers: improved tracking possibilities

THz imaging and radar
- Reducing the system complexity
- Real-time images.

Intra/on/off body communication
- Imaging and diagnosis
- Radio-controlled, “intelligent” medical devices

New fabrication technologies
Cross-disciplinary research

Innovative design of radiating systems

- RF & Microwaves
- Signal processing
- Electromagnetics
- Fabrication

VISTA  Versatile, Integrated, and Signal-aware Technologies for Antennas
Benefits of VISTA

- key research topics
- collaborative projects
- cross-disciplinary antenna system design

preserving European leadership
COST VISTA: Objectives

Coordinate cross-disciplinary research on integrated and versatile antennas for wireless applications,

- Assessment and survey
- Technological development
- Supporting technologies
- Cooperation & Networking
- Training and education
Scientific focus

Information harvested, transferred and delivered
wherever needed
whenever needed
however needed

WP2
Make it physically possible enabling technologies & integration

WP1
HOW wireless systems & applications

WP3
Understand and predict the possibility modelling & characterisation

WP4
Creating the possibility the people & the society
WP1: What? Applications and requirements

**Wireless home & office**
- enhanced systems for indoor data exchange
- Fast data synchronisation
- Cognitive & SW defined radio

**Mobility**
- Radar sensors
- Vehicle communications
- On-board infotainment
- Positioning systems

**Enhanced quality of life**
- health & medical applications
- business & industry automation
- Safety critical communications
- Remote sensing
- Non-invasive diagnostics
- Environmental monitoring
WP2: Enabling technologies and integration

- Higher # functionalities in a single compact device
- Higher data-rates and better service (single-antenna MIMO, etc)
- Efficient use of spectrum and energy (cognitive radio, etc.)
- Novel functionalities (e.g. satellite antenna mission update)

Reconfigurable antennas
Topic-wise...

• Remember that “VISTA = Versatile, Integrated, and Signal-aware Technologies for Antennas”!

• Focus on:
  – Multidisciplinary topics:
    – Link with novel fabrication technology
    – Evaluation of system-level performance, cross-layer design, in particular in radio coding (MIMO, cognitive, etc.)...
  – Higher frequencies up to THz (real time images, etc.)
  – Integration notably for mm-wave (60 GHz, 77GHz...) and reconfiguration
  – ‘Classical’ antennas requiring special evolution for ‘novel’ applications in WSN, medical, IR-UWB...
WP3: With what? Supporting technologies

- Simulation
  - Optimised Numerical methods
  - New tools
- Measurement
  - New techniques
  - Benchmarking
WP3: With what? Modelling and Characterisation

<table>
<thead>
<tr>
<th>Antenna modelling including environment</th>
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<tbody>
<tr>
<td>• Faster solvers</td>
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<td>• Algorithms requiring less memory.</td>
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<tr>
<td>• Hybrid methods,</td>
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<td>• Link with fast approximations</td>
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<td>• Multi-physics calculation</td>
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<tr>
<td>• Software tools for optimising</td>
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<td>matching circuits.</td>
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<td>• Parallelization of algorithms</td>
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<td>• New analytic approaches for complex</td>
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<td>media</td>
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<th>Advanced measurements</th>
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<tr>
<td>• Experimental validation of modeling</td>
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<tr>
<td>techniques</td>
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<td>• Near-field methods for new applications</td>
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<td>• Advanced methods for OTA test</td>
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<tr>
<td>procedures</td>
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<tr>
<td>• Millimetre-wave and TeraHertz</td>
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<tr>
<td>measurement techniques</td>
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<tr>
<td>• Measurement of ultra-small radiators</td>
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<tr>
<td>and time-varying media.</td>
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<tr>
<td>• Imaging and inversion techniques</td>
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<tr>
<td>(e.g. antenna diagnosis)</td>
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<tr>
<td>• Characterization of structured</td>
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<tr>
<td>materials (e.g. metamaterials)</td>
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WP 4: Who? Message to the broad public

**Goals**
- stimulating entrepreneurial and inquisitive attitude: basis for future progress

**Target groups:**
- the youth,
- the (not necessarily scientifically trained) public,
- the political stakeholders

**Dissemination**

**How:**
- access the wide public through media means

**raising the public awareness:**
- benefits & *factual* side effects
WP 4: Who? Training and Education

**Societal aims**

- Attract female students
- Capture the attention: events for & with children
- Correlate education efforts with industrial requirements
- Improve MSc and PhD students mobility

**VISTA**

Versatile, Integrated, and Signal-aware Technologies for Antennas
Versatile, Integrated, and Signal-aware Technologies for Antennas

WORKING GROUPS

- WG1 – Application requirements
- WG2 – Enabling technologies & integration
- WG3 – Supporting technologies
- WG4 – Societal aspects & ESR support

FOCUS AREAS

- FA A
- FA B
- \ldots
- FA n

COST Office

Chair
Vice-Chair
Secretary/Grant Holder

STEERING COMMITTEE

MC

TDC

• Other Actions
• Other Programmes
• Society
VISTA & Industry

- Industrial forum for practical input
- Exchange of ideas (blue sky research)
- Human resources (researchers, networking)

Human resources (researchers, networking)

VISTA Versatile, Integrated, and Signal-aware Technologies for Antennas
Output

Training and education
- Mobility through STSM (>10/year)
- Courses
- Teaching material

Durable cooperation
- Industry-University
- Spin-off projects

Technical outputs
- Recommendations for future applications
- Technical documents
- Algorithms & measurements
- Benchmarking activities
Signatory countries: 26 (+1?)

<table>
<thead>
<tr>
<th>Country</th>
<th>Date</th>
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<tbody>
<tr>
<td>Austria</td>
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<td>Belgium</td>
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<td>Bulgaria</td>
<td>19/08/2011</td>
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<td>Croatia</td>
<td>06/12/2011</td>
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<td>Cyprus</td>
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<td>Czech Republic</td>
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<td>Denmark</td>
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<td>France</td>
<td>12/08/2011</td>
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<td>Greece</td>
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<td>Turkey</td>
<td>29/09/2011</td>
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<tr>
<td>United Kingdom</td>
<td>18/07/2011</td>
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VISTA Versatile, Integrated, and Signal-aware Technologies for Antennas
Non-COST & others

Prof. Yahia Antar, Royal Military College of Canada

Prof. Richard W. Ziolkowski, University of Arizona

Prof. Krzysztof A. Michalski, Texas A&M University

Prof. Igor Djurovic, University of Montenegro

Dr. Albert Lysko, Meraka Institute Council for Scientific and Industrial Research

Prof. Takamaro Kikkawa, Hiroshima University

vista

Versatile, Integrated, and Signal-aware Technologies for Antennas
Facts and Figures: 94 Institutions

- Industry: 18
- Research centres: 12
- University: 58
- European Bodies: 1

Pie chart showing:
- University: 66%
- Research centres: 14%
- European Bodies: 1%
- Industry: 19%
Facts and Figures: 130 Researchers

Gender
- Male: 90%
- Female: 10%

Experience
- No ESR: 60%
- ESR: 40%
Welcome to COST VISTA (IC1102)

Communications and sensing in varying wireless environments require resilient, adaptive antenna systems for reliable data transmission and seamless access to various infrastructures. The emergence of new technologies in radio coding and the need for more efficient use of the spectral and energy resources shifts antenna system design towards cross-disciplinary approaches, covering electromagnetic field theory, RF engineering, signal processing, integrated fabrication technologies and even micro- and nano-technologies.

With these new challenges, it is vital to review the existing expertise and direct the efforts in the right direction. This COST Action identifies key research topics, facilitating the networking and coordination between different R&D teams. The objectives are to assess the needs for the new technologies and applications, to foster the development of radiating systems in green, smart environments, to provide the necessary supporting technologies and to promote the career start of young researchers.

www.cost-ic1102.eu or www.cost-vista.eu
COST VISTA LinkedIn group

• 66 members
• Quick information exchange
Versatile, Integrated, and Signal-aware Technologies for Antennas

**Working Groups**
- WG1: Requirements
- WG2: Enabling technol.
- WG3: Supporting technol.
- WG4: Societal aspects

**Focus Areas**
- FA-A Medical apps
- FA-B THz apps
- FA-C Parallel computing
Thank you for your attention...

31-8-2012