Proposal for an ESF Research Networking Programme – Call 2008

Section I: *(1 A4 single page)*

Programme title:

"New frontiers in millimetre / sub-millimetre waves integrated dielectric focusing systems"

Programme acronym:

"NEWFOCUS"

Acronym of the Standing Committee:

PESC

Name and full coordinates of principal applicant(s) (*up to three including the contact person*):

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Indication of which of the principal applicants is the contact person:

Dr. Ronan SAULEAU

Keywords relating to the topic of the proposal (*up to five; one "keyword" can be a string of not more than three words*):

Information and Communication Technologies (ICT); Dielectric focusing systems; Computational electromagnetics; Electromagnetic synthesis / optimisation; Integrated sensors.

Abstract of the proposal (*max. 300 words*):

This 5-year research Network gathers the most qualified teams in Europe with unique and strong background and expertise on "integrated dielectric focusing systems at millimetre and sub-millimetre waves". The whole spectrum of the fundamental know-how required to push the frontiers in the area covered by the Network will be assembled to strengthen, consolidate and produce a significant added value at the European level in terms of research and education. These fields of expertise include (1) Advanced analytical and numerical modelling techniques in electromagnetic theory using complementary formulations (full-wave modelling in time and frequency domains, high-frequency and asymptotic techniques, spectral approaches) for the analysis, the synthesis and the optimisation of integrated dielectric focusing systems, (2) Powerful computer-aided-design tools developed by the partners of the Network, and (3) Unique measurement facilities at millimetre and sub-millimetre waves. In its present form, the Network gathers 15 academic partners from 12 countries (Croatia, Finland, France, Germany, Greece, Italy, Portugal, Switzerland, The Netherlands, Turkey, UK, and Ukraine). The main expected achievements are the following: (1) Coordination, consolidation and exploitation of the research expertise in Europe, (2) Advanced education (creation of courses for the post-graduate European School of Antennas), (3) Inciting mobility and researcher exchanges (travel grants for short term scientific missions), (4) Sharing existing expertise and overall benchmarking, (5) Development of new design techniques / tools and innovative antenna concepts, and (6) Dissemination of know-how (creation of a website, organisation of scientific workshops and special sessions in international conferences, publication of one reference book, publications in scientific journals and international conferences).

Previous or concurrent applications to the ESF for any of the ESF instruments:

This project was submitted to the same call for proposals in 2007. The three Reviewers recommended its funding, but asked to explain the interactions with the NoE ACE. This new version easily clarifies this point since ACE ended in Dec. 2007. All other Reviewers' suggestions made on our previous proposal have been taken into account.

Section II: *(not more than 8 A4 single pages / max. length 3000 words)*

Section II.1 – Status of the relevant research field; scientific context, objectives and envisaged achievements of the proposed Programme

Integrated dielectric focusing systems: general introduction

At millimetre and sub-millimetre waves (f > 30GHz), moderate or high-gain radiating structures (**Fig. 1**) are key devices to establish point-to-point and point-to-multipoint radio links for far-field and near-field applications. In this frame, **quasi-optical technologies**, and in particular **integrated dielectric focusing systems**, are extremely attractive due to their outstanding and unique figure of merit in terms of performance and cost.

The major goal of this 5-year Research Network Programme (RNP) is to gather and share unique expertise and know-how on dielectric focusing systems (*and* feeds) spread all over Europe, in order to strengthen and consolidate education and research in this field. More specifically, the fifteen partners of this RNP (Croatia, Finland, France, Germany, Greece, Italy, Portugal, Switzerland, The Netherlands, Turkey, UK, and Ukraine) will focus their networking activities onto generic integrated dielectric focusing systems and their associated feeds / sensors. The main antenna technologies covered by this project are highlighted in green in **Fig. 1**.

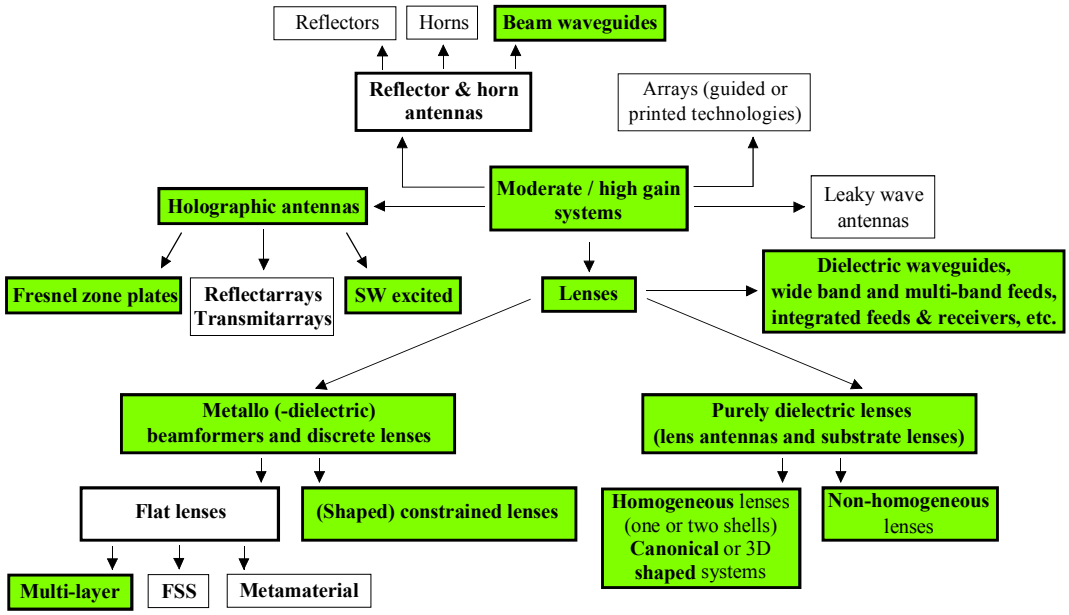


Fig. 1. Proposed classification of integrated dielectric focusing systems. The technologies shown in green constitute the **scientific and technological core** of the Network 'NEWFOCUS'.

By definition, any generic integrated dielectric focusing system consists of an arbitrary focusing device combined with a set of arbitrary primary feeds (emitting mode, antennas) or detectors (receiving mode, integrated electromagnetic sensors):

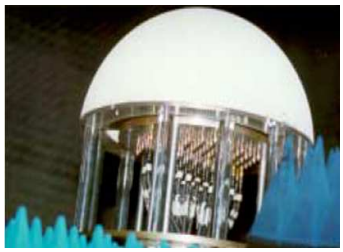
- The focusing device is usually built from a set of dielectric or metallo-dielectric lenses of arbitrary shape and size, and made of various homogeneous or non-homogeneous constitutive materials,
- The feeds and detectors are 2-D or 3-D, passive or active devices that may be *integrated* at the "system" base and be arranged into arrays, e.g. for the design of reconfigurable, beam forming or beam steering antennas and high-resolution receiving / surveillance / diagnostic systems.

Such systems are involved in a wide number of ICT applications ranging from microwaves to THz and requiring beam shaping, beam switching, beam steering or multiple-beam capabilities. A non-exhaustive list of applications is given below:

- Broadband high data-rate indoor (smart home, gigabit offices) & outdoor wireless communication systems around 26GHz, 30GHz, 40GHz, 60GHz, 110GHz and 150GHz,
- Wireless Personal Area Networks (WPANs) in the 60-GHz band,

- Intelligent Transport Systems (ITS), e.g.:
  - Short range / long range / multi-function automotive radars at 77GHz (e.g. **Fig. 2a**) and, in the near-future, from 76GHz to 81/82GHz for ultra wide band (UWB) high-resolution radars,
  - Road Traffic & Transport Telematics [RTTT] at 63/64GHz for communications between vehicles, as well as between vehicles and infrastructures,
- Communications with LEO (e.g. **Fig. 2b**), MEO and GEO satellites in Ku-, Ka- and Q-bands (domestic and professional uses, communications with moving platforms like high-speed trains, etc.),
- Communications with high-altitude platforms (HAPs) around 47/48 GHz,
- Communications between satellites, between aircrafts, and between ground and civil / military aircrafts,
- Passive and active imaging / sensing, security and surveillance systems in public areas (airports, stations, etc.) at millimetre and sub-millimetre waves,
- Instrumentation (time-domain spectroscopy, quasi-optical receivers and systems, reference antennas for time-domain measurements, diagnostic procedures, non-destructive testing applications, plasma studies, etc.).

(a) Automotive radar @ 77GHz (from Robert Bosh Gmbh)



(b) Dome antenna for satellite communications (from Thales Alenia Space)

Fig. 2. Examples of dielectric focusing systems for ICT applications.

Scientific and technical context at the European and international levels

Except several institutions in North America (e.g. Georgia Tech., Univ. of Colorado, Univ. of Michigan, Univ. of California (San Diego), Utah State Univ., the US Air Force Laboratory, Pharad LLC, Raytheon (California), Univ. of Toronto, Univ. of Ottawa), South America (Technical Univ. Federico Santa Maria), Australia (e.g. RMIT Univ., Melbourne), and Japan (e.g. NICT, Tohoku Univ., Doshisha Univ.), most of the research power in integrated dielectric focusing systems is concentrated in Europe, but *disseminated* between many countries and institutions (universities, agencies, etc.). One of the key added values of the proposed RNP is that it gathers the majority of the most active research teams in this area in Europe.

As explicitly required, the list of European R&D networking activities directly related to the proposal, and already existing collaborations activities, are given in Section II.4 (page 5). **This list demonstrates undoubtedly that there is presently no established R&D networking activities in Europe directly related to the proposal, and that the proposed RNP is really complementary to all previous or existing R&D activities**.

Current status of the research in Europe, and motivations for creating the Network

The research in Europe in the field of interest of the proposed Network is extremely active, in particular because of the very large number of already existing and emerging applications involving integrated dielectric focusing systems (see above).

Nevertheless, the research effort is spread between more than fifteen research centres (universities, national agencies, etc.). Many research studies are overlapping and duplicated; on the contrary, others are really complementary, and bridges between them must be built for creativity and innovation. On the other hand, due to the wide diversity of existing technologies (**Fig. 1**), complementary electromagnetic (EM) modelling techniques (modal decompositions, high-frequency and asymptotic methods, integral equations, time-domain approaches, multi-scale methods, etc.) and Computer-Aided Design (CAD) tools have been developed over the past ten years in Europe, mainly because no commercial

EM tool allows today the accurate, efficient and fast analysis of integrated dielectric focusing systems. In addition, it will be shown in Section II.4 that all previous initiatives (**Table 2**, page 6) only gather a limited number of partners and do not cover the whole spectrum of expertises and know-how (namely: numerical modelling, advanced design methodologies, fabrication & prototyping, experimental characterisation) that are strictly required to push the frontiers in the design and synthesis of integrated dielectric focusing systems. Moreover **Table 1** (page 6) provides a list of on-going joint projects between several partners of this Network, demonstrating thereby a certain level of already-existing co-operation on common research interests on shaping / focusing systems: such initiatives must be absolutely consolidated. Finally, many theoretical and technological challenges need to be solved in the future, e.g. the modelling and optimal design of highly-integrated focusing systems, or the full-wave synthesis of passive / active (reconfigurable / smart) configurations.

Research challenges to be addressed

Consequently, given the above-mentioned observations, there is undoubtedly a crucial need in sharing knowledge, expertise and know-how in order to master all design and technological stages, including – in the long term:

1. The development of analytical / numerical techniques and accurate professional quasi-optical CAD tools, including the reliable and fast automatic optimisation / synthesis of electrically-large quasi-optical systems with fine details, and wavelength-scale scatterers. The ultimate goal is to reach an accuracy and efficiency that would be comparable to that of reflector antenna CAD tools,
2. The design of high-performance and innovative antenna concepts for the above-mentioned applications. This includes (non-exhaustive list): i) High-radiation and aperture efficiency lenses, ii) Reconfigurable focusing systems, iii) Integrated UWB focusing systems, iv) Shaped-beam and multiple-beam lenses, v) Broadband integrated feeds for transmitter and receiver systems, vi) Highly-integrated transceiver modules with integrated focusing systems, vii) Planar imaging beam forming networks, viii) Spherical scanning antennas, etc. Such achievements can be reached only if advanced EM analysis, synthesis and optimisation procedures are developed, validated and benchmarked,
3. Fabrication and packaging techniques for 3D integrated focusing systems (including passive and active feeds), and accurate measurement methods at sub-millimetre and THz ranges.

To reach these ultimate goals and produce a significant breakthrough, networking and restructuring of the research on integrated focusing systems at the European level is vital and necessary. This clearly constitutes the major motivations of our proposal.

Objectives of the Network, Expected results and Achievements

The prime objective is to gather, organize, coordinate and exploit the activity of the most-qualified research groups in Europe in the field of integrated focusing systems and technologies from microwaves to THz. To this end, the creation of a Research Network on ‘integrated dielectric focusing systems’ (acronym: NEWFOCUS) is proposed.

The detailed goals of NEWFOCUS are described below:

1. **R&D networking**:
    a. Sharing know-how and expertise in the following areas: advanced numerical modelling, design, prototyping & measurement techniques,
    b. Benchmarking infrastructures, methods and design tools,
    c. Developing new techniques in the following areas: i) EM synthesis & optimisation; ii) Innovative antenna concepts (e.g. integrated circuit for broadband transmitter and receiver systems, quasioptical and dielectric waveguides, components and systems, etc.); iii) New fabrication methods; iv) New characterisation methods; v) New (artificial) materials,
    d. Inciting mobility of PhD students, post-doctoral fellows, junior / senior researchers (open call for applications to travel grants),

e. Extending and promoting co-operations between partners,
f. Defining joint scientific orientations on integrated focusing systems,
g. Proposing research projects on focusing systems (e.g. STREP projects);

2. **Training** young scientists:
   a. Organising research training on integrated focusing systems,
   b. Creating and updating post-graduate courses on quasi-optical systems and analytical / numerical modelling. This is presently included in the European School of Antennas 'ESoA' (coordinated by the Univ. of Siena, partner of this RNP); but the ESoA programme finishes in 2009;
3. **Organising** special sessions and workshops in European and international conferences;
4. **Disseminating and exploiting** know-how and expertise for education and research purposes: organisation of scientific meetings and schools, creation of a dedicated local website, regular news letters and publicity actions, publication of one reference book, publications in scientific journals.

The detailed description of the work to be carried out is given in Section II.5.

Section II.2 – Facilities and expertise which would be accessible by the Programme

The facilities and expertise accessible to the Network are those available to the partners of the consortium, namely:

- Analytical and semi-analytical modelling: theoretical description of formulation adopted with related ad-hoc softwares to be integrated into full-wave analysis schemes,
- Numerical modelling (analysis, synthesis, optimisation) using full-wave, high-frequency and asymptotic methods: commercial electromagnetic 2.5-D and 3-D software, in-house developed CAD tools, high-performance computing platforms,
- Prototyping: mechanical workshops (3-axis CNC milling machines, etc.),
- Experimental characterisation: unique instrumentation setups in Europe at millimetre and sub-millimetre / THz waves (vector network analysers, spectrum analysers, near-field and far-field anechoic chambers, compact antenna test ranges, hologram-based test ranges, characterisation of dielectric materials, millimetre-wave channel sounders).

Section II.3 – Expected benefit from European collaboration in this area

Progress beyond the state-of-the-art, expected benefit from European collaboration and open character of the Network

Gathering the most-qualified teams will ensure a considerable added value from the research and educational point of views. This is clearly demonstrated not only by the structure of the Network itself (one WP is dedicated to education, two WPs are for research networking and new techniques), but also by the expected achievements, namely: coordination, consolidation, and exploitation of the research in Europe, inciting mobility of young and senior researchers, organisation of science meetings, attraction of new skills, open calls for applications to deliver grants for short and exchange visits, writing a reference book, creation of a website, evolution of the Network during its lifetime.

Section II.4 – European context (list of relevant R&D networking activities at the European level directly related to the proposal, and already existing or envisaged collaboration activities, in particular, networks or activities under the EC Framework Programme, COST or under any other international programmes or organisations. State how the Programme would complement these and any applications on this or a similar topic to these organisations)

Although focusing systems have been investigated (only in part) as potential technologies specifically selected to reach the goals of a collection of national / European projects (**Table 1**), **there is presently no established R&D networking activities in Europe directly related to the proposal**.

To our best knowledge, there are only five recent initiatives with the aim of restructuring research and education in Europe in the fields of interest of the proposed RNP (**Table 2**). Nevertheless, as explained in **Table 2**, these initiatives only cover an extremely small part of the scientific area of NEWFOCUS. In addition, at least three of them are expected to finish in 2009, and there will be no alternative instrument in Europe to fill in the corresponding gaps, except the NEWFOCUS RNP.

Kind of project	Examples of projects (non-exhaustive list)
European projects	- High-altitude platforms: FP5/HeliNet (finished), FP6/CAPANINA (finished), COST 297 (COST 297 may offer immediate and relevant dissemination route for communications to HAPs / air vehicules). - NoE Antenna Centre of Excellence 'ACE' (this NoE is now finished. NEWFOCUS will be much more specific and go much deeper than ACE with short-term scientific missions, measurement campaigns, workshops, etc.).
Other projects (funded by indust. or agencies)	- ESA-ESTEC: ILASH, MULTISCAN, EAML. - France: CNES: Dome. - Luneburg lenses (the US Air Force Laboratory). - Finland / TEKES: Integrated lens antennas for Gigabit offices. - The Netherlands: TNO + SRON (ultra broadband sub-mm wave lenses).
Bilateral projects	- IETR (F) + IT/IST (P): Researcher mobility, National co-funded. - IETR (F) + IRE (UA): Researcher mobility, National co-funded. - Univ. Siena (I) + TNO (NL): Exchange of PhD students.

Table 1. Examples of recently completely or running projects where 'integrated focusing systems' are involved.

Initiative acronym	Main features and key differences with the proposed RNP
ELLA (European Laboratory on Lens Antennas)	- R&D Networking. Initiative of 7 partners participating in the NoE ACE. All ELLA partners (except the SME TICRA) are involved in this Network. - Coordination: IETR (Dr. R. Sauleau). - Present situation: No funding for networking beyond the end of ACE (i.e. after Dec. 31, 2007).
European School of Antennas (ESoA)	- Post-graduate school (10 courses per year and about 80 teachers coming from 20 European research centres in Europe Advanced Education). - Feature: at least four courses about large antennas (reflector and lens antennas), numerical and experimental techniques. - Coordination: Univ. of Siena (Prof. S. Maci). - Present situation: Marie-Curie Action ending in Dec. 2009. No alternative solution currently existing for 2010 and beyond.
RFR 2006 between France, Ukraine and Croatia	- Research and Training Network ('RFR' in French) about lens antennas. - Coordination: IETR (Dr. R. Sauleau). - Duration: 3 years (2006-2008). - Present situation: Funding by France, Project finishing in Dec. 2008, Expertise area is much more narrow than NEWFOCUS.
COST ASSIST IC0603	- R&D Networking for the Antenna community in Europe. - Present situation: The scientific area of NEWFOCUS will go much deeper into millimetre and sub-millimetre wave technologies, compared to COST ASSIST.
FP7/ARTIC (Antenna Research and Technology for the Intelligent Car)	- 2-year project (2008-2009). - Present situation: This project *only* focuses on antenna technology transfer, software and measurement best practice for the Intelligent Car Initiative (iCAR). Overlap with NEWFOCUS is extremely small (<5%).

Table 2. Already existing initiatives at the European level (education and research). The "Present situation" statement demonstrates the need for supporting NEWFOCUS.

Section II.5 – Proposed activities, key targets and milestones

Key features of the Network

- **Start month – End month**: From January 2010, to December 2014.
- **Consortium**: 15 research teams from 12 countries.
- **Multi-disciplinary character**: ICT, Applied mathematics, Electromagnetic theory.
- **Budget per year**: 135 kEuros in average (details are given in Section II.7, page 9).
- **Total asked budget**: 675 kEuros.

The Network is organized into **four work packages** (WPs):

1. WP 1: Management, dissemination of results, and exploitation,
2. WP 2: Education and training,
3. WP 3: Numerical and analytical modelling, design methodologies and experimental methods,
4. WP 4: Future trends: innovative antenna concepts and new techniques.

WP 1: Management, dissemination of results, and exploitation

Activity leader: IETR (France).

Objectives

- To coordinate the Network and make it evolve during its lifetime ('open' mode for new partners and / or non-ESF countries),
- To supervise the work of each WP and to coordinate the work between the WPs,
- To monitor costs along the duration of the project,
- To ensure timely dissemination of the results to the Antenna Community,
- To promote the Network activity (open character of the Network, publicity actions [Programme brochure and regular news letters, public scientific reports, etc.]),
- To promote new research projects and new partnerships, and exploit the results (IPR),
- To open the Network to advisory European and international experts (e.g. coming from space agencies like CNES, DLR, ESA, etc.).

Description of work

- Coordination of the Network, monitoring of the WPs, and interaction with the ESF,
- Organisation of the Steering Committee meetings (typically 1 meeting per year),
- Organisation of Science meetings (workshops & special sessions in international conferences),
- Definition of the research orientations for WP 3 and WP 4,
- Consolidation of the European research on integrated dielectric focusing systems (submission of joint proposals to national agencies and EU, publicity actions),
- Management of the open calls for applications (grants and researcher mobility),
- Incitement to researcher exchanges among the Network partners (travel grants) and attraction of new skills from outside the Network,
- Dissemination of the results: creation of a local website, publication of a collective book (numerical techniques, design methodologies, applications, fabrication and measurement techniques), creation of a technical database at the European level (lens library), publications of the results achieved in WP 3 and WP 4,
- To encourage and monitor the generation of IPR by partner members and encourage its exploitation by both public agencies and private industry.

Main envisaged achievements and deliverables

- Creation of a local website (state-of-the art on lens antennas and existing know-how in the world, future trends, online educational courses, online lens library),
- Consolidation of the researcher mobility,
- Sharing of expertise and know-how at the European level,
- Organisation of workshops & special sessions in international conferences,
- Participation in nationally-funded and EU-funded projects,
- Publications in scientific journals and in international conferences,
- Publication of one reference scientific book on integrated focusing systems,
- Deliverables: two activity reports (mid-term and final reports) summarizing the whole activity and the main achievements of the Network.

WP 2: Education and training

Activity leaders: University of Siena (Italy), and Institute of Radiophysics and Electronics, (Ukraine).

Objectives

- To organize research training on focusing systems (numerical methods, design techniques, measurement procedures),
- To create and update post-graduate courses on integrated lens antennas and quasi-optical technologies and systems.

Description of work

- Organisation of a one-week post-graduate school every two years. The corresponding

courses will be included in the European School of Antennas ESoA (because of practical works, the maximum number of attendees is limited to 30),
- Definition of the contents of the courses (lectures, exercises, practical works: experimental characterisation of focusing systems using unique measurement facilities available among the Network partners),
- Editing the course proceedings.

Main envisaged achievements and deliverables

- Organisation of at least three 5-day post-graduate schools in Years 1, 3 and 5,
- Publication of the course proceedings,
- Deliverables: three activity reports, one for each of the three schools.

WP 3: Numerical and analytical modelling, design methodologies and experimental methods

Activity leaders: Technical University of Lisbon (Portugal), IETR (France) and University of Modena and Reggio Emilia (Italy).

Objectives

- To identify available know-how and expertise in Europe and outside, in terms of numerical and analytical modelling, design, prototyping & measurement techniques,
- To define the state-of-the-art on integrated dielectric focusing systems in the world,
- To benchmark infrastructures, methods and design tools,
- To improve existing CAD tools and develop new design techniques.

Description of work

- Determination of the know-how and technologies available in Europe based on detailed contributions provided by all RNP partners,
- Benchmarking infrastructures, methods and CAD tools (analysis, synthesis, optimisation), in particular through travel grants awarded for short and exchange visits,
- Development of analytical and numerical methods: Geometrical Optics (GO), Physical Optics (PO), GO/PO, PO/PO, High-frequency diffraction techniques (GTD/UTD), Integral equations, Green's functions for layered media and MoM, Time-domain formulations (for bodies of revolution or arbitrarily-shaped focusing systems). The analytical techniques will start from suitable canonical problems,
- Contribution to the improvement of already-existing softwares to significantly increase the design capabilities. The resulting programs will be developed in strong co-operation between the research groups of NEWFOVUS,
- The facilities (CAD tools, measurement systems etc.) that will be assessed are those accessible through the Network (i.e. those provided by the consortium),
- Supply of numerical and experimental data for dissemination of the results (WP 1).

Main envisaged achievements

- Improvement of the researcher mobility and CAD tools, benchmarking,
- Deliverables: two activity reports (mid-term and final reports) with the following contents: summary of the state-of-the-art in Europe and in the world on dielectric focusing systems, achievements (benchmarking, new tools).

WP 4: Future trends: innovative antenna concepts and new techniques

Activity leaders: TKK Helsinki University of Technology (Finland), and TNO Defense (The Netherlands).

Objectives

- To identify new concepts of integrated dielectric focusing systems and new techniques from the numerical, technological (integration) and experimental standpoints.

Description of work

- Determination of new concepts and applications for integrated dielectric focusing

systems (near-field and far field applications),
- Identification of (1) new numerical modelling techniques and applied mathematics, (2) innovative design methodologies and concepts, (3) new integration and fabrication techniques (accounting for the challenging requirements at millimetre and sub-millimetre waves), and (4) new measurement techniques.

Main envisaged achievements

- Deliverables: two activity reports (mid-term and final reports) with the following contents: detailed description of the new techniques listed above, definition of the specifications, potentialities and needs for each technique,
- Submission of proposals for nationally-funded and EU-funded projects.

List of deliverables

Del. No.	Deliverable name	WP No.	Delivery (project month)
D1.1	Mid-term activity report of the Network	1	M30
D1.2	Final activity report of the Network	1	M60
D2.1	First activity report on the School	2	Within 2 months of the event
D2.2	Second activity report on the School	2	Within 2 months of the event
D2.3	Third activity report on the School	2	Within 2 months of the event
D3.1	Mid-term activity report of WP 3	3	M30
D3.2	Final activity report of WP 3	3	M60
D4.1	Mid-term activity report of WP 4	4	M30
D4.2	Final activity report of WP 4	4	M60

Table 3. List of deliverables.

Section II.6 – Duration (48 or 60 months): 60 months

Section II.7 – Budget estimate (in €) by type of activities and per year of the Programme

(Please use the headings listed in the section "*Level and use of a Programme budget*" of the Call, as appropriate. Do **not** include the ESF administration fee in the annual budget. This is calculated and included by the ESF office before submission for funding to MOs):

Type of activity	Year 1		Year 2		Year 3		Year 4		Year 5		Total / activity
WP 1	St-M: Sc-M: PUB: EXT:	16.5 4 4 3.5	St-M: Sc-M: PUB: EXT:	15 4 4 3.5	St-M: Sc-M: PUB: EXT: Mid-M:	16.5 4 4 3.5 5	St-M: Sc-M: PUB: EXT:	15 4 4 3.5	St-M: Sc-M: PUB*: EXT: Fin-M:	16.5 4 12 3.5 6	156 k€
WP 2	SCH:	3	--	--	SCH:	3	--	--	SCH:	3	9 k€
WP 3	Gts-e:	50.5	Gts-e:	50.5	Gts-e:	50.5	Gts-e:	50.5	Gts-e:	41	243 k€
WP 4	Gts-s:	14.2	Gts-s:	14.2	Gts-s:	14.2	Gts-s:	14.2	Gts-s:	14.2	71 k€
Total / year	95.7 k€		91.2 k€		100.7 k€		91.2 k€		100.2 k€		479 k€

Table 4. Budget (**in k€**) – (1 k€ = one thousand Euros).

WP 1: Management, dissemination of results, and exploitation. **WP 2**: Education and training. **WP 3**: Numerical modelling, design methodologies and experimental methods. **WP 4**: Future trends: innovative lens antenna concepts and new techniques

- **St-M** = Steering Committee Meetings (typ. 1 meeting / year, and eventually 1 sub-meeting).
- **Sc-M** = Science Meetings (workshops, special sessions in international conferences).
- **Mid-M** / **Fin-M** = Mid-term evaluation ESF Meeting / Final evaluation ESF Meeting.
- **SCH** = Participation to the organisation of the post-graduate school (Y1, Y3 and Y5).
- **Gts-s** Travel grants for short visits (up to 15 days).
- **Gts-e** = Travel grants for exchange visits (from 15 days to 6 months).
- **PUB** = Publicity, Dissemination, and External programme coordinator (development and up-dating of the external local website, editing reports, publication costs, database cost, etc.). **PUB***: During Year 5, the extra-cost is due to the book publication fees.
- **EXT** = External administrative cost (up to max. 10% of the annual budget).

Section III: *(not more than 3 A4 single pages + 1 single page for global dimension if applicable)*

List of names and full coordinates of the **envisaged Steering Committee members listed by country** in alphabetical order (One member per collaborating country; this can be a provisional list and names can be added to it later)**:**

Each member of contributing countries will be a voting member, as indicated in **Table 5**. Prof. A. Nosich, advisory expert from IRE, Ukraine, will be invited to attend to meetings of the Steering Committee (**Table 6**). The management rules are those explicitly described by ESF in its guidelines.

#	Country	Proposed member	Short CV, background and expertise
1	**Croatia**	Prof. Z. Sipus zvonimir.sipus@fer.hr	44 years-old. PhD (Chalmers Univ., 1997). Full Professor at the Univ. of Zagreb. Head of the Department of Wireless Communications. Adjunct researcher at the Dept. of Electromagnetics, Chalmers University of Technology, Gothenburg, Sweden (1999-2005). Expertise: 15-year expertise in analytical / numerical methods in EM theory, and optical communication systems; Development of EM softwares for analyzing planar, cylindrical and spherical antennas and scatterers. Author or co-author of more than 30 papers in international journals, and more than 100 papers in international conferences.
2	**Finland**	Prof. A. V. Räisänen antti.raisanen@tkk.fi	58 years-old. IEEE Fellow since 1994. Expertise: Coordination of research in mm-wave components, antennas, receivers, measurements, etc. at TKK Dept. of Radio Science and Engineering & MilliLab (Millimetre Wave Laboratory of Finland – ESA External Laboratory). Head of Smart and Novel Radios Research Unit (SMARAD) (national status of Center of Excellence in Research from the Academy of Finland). Author or co-author of more than 400 scientific papers and six books. Conf. Chairman for 4 int. microwave and mm-wave conferences. Associate Ed. of the IEEE Trans. On MTT from 2002-2005. Member of the BoD of the European Microwave Association (2006-08).
3	**France**	Dr. R. Sauleau	36 years-old. Refer to Section 4 for the CV.
4	**Germany**	Prof. Dr.-Ing. L.-P. Schmidt lps@lhft.eei.uni-erlangen.de	58 years-old. Dr.-Ing. Degree in 1979. In 1979 Post Doc. Research Associate at the University of Texas. In 1980 start industrial career at AEG-Telefunken (now EADS). Then head of several microwave and millimeter wave research groups and coordination of corporate research activities. R&D in the field of hybrid MIC, MMIC, antennas and systems up to 150 GHz. Since 1998 Full Professor and Head of the Institute for Microwave Technology, Univ. of Erlangen-Nuremberg. Expertise: mm-sub-mm wave component & antenna design and technology, active and passive imaging systems up to the THz region. In 2003 General Chairman of the EuMW and Chairman of the EuMC. Member of VDE, IEEE Senior member, member of the German IEEE MTT/AP-Chapter.
5	**Greece**	Dr. N. L. Tsitsas ntsitsas@esd.ntua.gr	29 years-old. PhD in electrical engineering (2006), MSc in applied mathematics (2005). Expertise: Analytical & numerical methods in wave-scattering and radiation theory, propagation in optical waveguides, mathematical modeling of optical devices, applied mathematics and numerical linear algebra, numerical modeling of lens antennas. Member of the IEEE, the Optical Society of America, the American Mathematical Society.
6	**Italy**	Prof. S. Maci macis@dii.unisi.it	47 years-old. IEEE Fellow since 2003. Full Professor at the Univ. of Siena. Head of a group of 16 among associate and assistant prof., 6 Post-Doc and PhD students. Expertise: High-frequency methods for radiation and scattering problems, ii) hybrid integral equation/asymptotic methods, large phased array antennas, planar antennas and multilayer structures, lens antennas and focusing systems, reflector antennas and metamaterials. Responsible of about 32 research projects (EU, MIUR, ESA-ESTEC, etc.). Coordinator of the “European School of Antennas”. He was an Assoc. Ed. of IEEE Trans. on EMC and he is presently an Assoc. Ed. of of IEEE Trans. Antennas Propagat. Author or co-author of about 90 papers in international journals and book chapters, and about 200 papers in international conferences.
7	**Portugal**	Prof. C. A. Fernandes carlos.fernandes@lx.it.pt	51 years-old. PhD (1990, Instituto Superior Técnico , Technical Univ. of Lisbon). Since 2006, Full Prof. at the Dept. of Electr. and Comput. Eng. in the areas of microwaves, radio wave propagation and antennas. Senior researcher at the Instituto de Telecomunicações, Coordinator of the Wireless Communications scientific area. Expertise: antenna design (e.g. artificial dielectrics, dielectric antennas for mm-wave applications), design and optimisation of lenses (homogeneous shaped integrated lenses, single- or dual-shell UWB lenses; more than 50 different lens prototypes were fabricated at IT/IST), and radio wave propagation

			modelling. Leader of the antenna activity in National and European Projects as RACE 2067 - MBS (Mobile Broadband System), ACTS AC230 - SAMBA (System for Advanced Mobile Broadband Applications) and ESA/ESTEC - ILASH (Integrated Lens Antenna Shaping). Author or co-author of two book chapters, and more than 40 papers on lens related subjects in Journals and Conference proceedings.
8	**Switzerland**	Prof. J. Mosig Juan.Mosig@epfl.ch	57 years-old. IEEE Fellow. PhD deg. (1983, Laboratory of Electromagnetics and Acoustics (LEMA) at Ecole Polytechnique Fédérale de Lausanne (EPFL)). Since 1991, Professor at EPFL, and since 2000, Head of the EPFL-LEMA. Visiting Research Associate in 1984 at Rochester Inst. of Technology, NY, and scientific appointments at Universities of Rennes and Nice in France, Technical University of Denmark and University of Colorado at Boulder. Author or co-author of 4 chapters in books on microstrip antennas and circuits and more than 100 reviewed papers. Co-organiser and lecturer of yearly short intensive courses in Numerical Electromagnetics (Europe and USA). Member of the Swiss Federal Commission for Space Applications, Chairman of a European COST action on antennas, and Responsible of several research projects for the European Space Agency. Expertise: electromagnetic theory, numerical methods and planar antennas.
9	**The Netherlands**	Dr. A. Neto A.Neto@tudelft.nl	40 years-old. PhD degree in Electric. Engineer. (Univ. of Siena, 1999). IEEE Member. Professional experience: European Space Agency (95-96, 98-99), Post-Doctoral fellow at Jet Propulsion Lab. (California, 00-01), Senior antenna scientist at TNO since 2002. More than 50% of his work is financed by research projects from ESA while the remaining work is performed in the frame of TNO knowledge development programs. Expertise: EM modeling, Quasi-optical technologies (lens and reflector antennas), Electromagnetic band gap structures, Imaging arrays. Author or co-author of 35 peer reviewed journal papers (over 20 in IEEE Trans.) and 140 conference contributions. He holds four antenna patens (three of these are new lens antennas). He received a few important gratifications: 1) NASA Certificate of Recognition (2001) (work on sub-mm wave lenses); 2) TNO Publication Prize (2005) (work on sub-mm wave mixers); 3) Innovation Prize at the 2008 ESA Antenna Conference (work on connected arrays); 4) His work on UWB leaky lenses was the top downloaded article for the IEEE Antennas and Propagation Website in Oct. 2007. 5) The 2008 IEEE Wheeler Award for the best applicative paper in the IEEE Trans. on Antennas and Propagation (work on EBG based antennas). Specifically in the frame of Dielectric Lens antenna, his present cooperation is with SRON (Netherlands Organisation for Space Research) and JPL (NASA). 2008 Wheeler Award Paper.
10	**Turkey**	Prof. A. Altintas altintas@ee.bilkent.edu.tr	50 years-old. PhD (Ohio State University, 1986). Full professor. Visiting Prof. positions at the Technical University of Munich, Tokyo Institute of Technology, and Concordia University, Montreal. He has been a Fulbright Scholar and Alexander von Humboldt Fellow, and a recipient of IEEE Third Millennium Medal. Author or co-author of more than 100 publications. Member of Phi Kappa Phi, Sigma Xi, IEEE Senior Member, Chair of URSI Commission B of Turkey. Expertise: High-frequency and ray techniques, and computational EM.
11	**UK**	Prof. V. Fusco v.fusco@ecit.qub.ac.uk	51 years-old. DSc, PhD, BSc, FREng, IEEE Fellow, IEE Fellow, CEng. Personal chair in High Frequency Electronic Engineering in 1995. Head of the high frequency laboratories at QUB. He has published 350 scientific papers in major journals and in intern. conf. He holds several patents and has written 2 books. In 1986 he was awarded a British Telecommunic. Fellowship, and 1997 he was awarded the NI Engineering Federation Trophy for outstanding industrially relevant research. Expertise: active and passive antenna solutions at microwaves and mm-waves. He has lead 18 major EPSRC programs related to microwave and mm-wave antennas (micromachined frequency selective surfaces, microwave interconnects, planar Luneberg lenses) and MMIC technologies. Strong relationships with Agilent, OMMIC, Astrium EADS and US Air Force.

Table 5. Proposed composition of the Steering Committee (1 member per country, as required).

Ukraine	Prof. A. I. Nosich alex@emt.kharkov.ua	55 years-old. IEEE Fellow since 2004. Ph.D. (79), and D.Sc. (90). Since 1979, he has been with IRE NASU, Kharkov, where he is currently a full Professor and Leading Scientist. Since 1992, he has held a number of guest Fellowships and Professorships in the EU, Japan, Singapore, and Turkey. From 2001 to 2003, he represented Ukraine, Poland, and the Baltic States in the European Microwave Association. Prof. Nosich is the head of the MOCA Group (Modeling of Optoelectronic Components and Antennas). Expertise: integral equation (IE) methods, method of analytical regularization, propagation and scattering of waves in open waveguides, electromagnetic analysis of semiconductor lasers, passive and active dielectric resonators, reflector antennas, lens antennas.

Table 6. Advisory expert for the Steering Committee.

Programme Collaborations: names and affiliations (including department, institute, university) of the **researchers/research groups** that are foreseen to participate in the Programme's activities **listed by country:**

The proposed Network includes 15 teams from 12 countries (**Table 7**). This is a unique Network gathering complementary expertises and know-how in numerical modelling, lens antenna design, focusing systems, and antenna characterisation.

#	Country	ESF member	Institution	Contact person
1	**Croatia**	Yes	**University of Zagreb**, Faculty of Electrical Engineering and Computing, Department of Wireless Communications, Unska 3, HR-10000 Zagreb	Prof. Z. Sipus
2	**Finland**	Yes	**Aalto University**, School of Science and Technology, Dept. of Radio Science and Engineering, SMARAD Center of Excellence and MilliLab, PO Box 13000, FI-00076 Aalto, Finland	Prof. A. V. Räisänen
3	**France**	Yes	**University of Rennes 1**, The Institute of Electronics and Telecommunications of Rennes, Avenue du Général Leclerc, 35042 Rennes cedex	Prof. R. Sauleau
4	**Germany**	Yes	**University of Erlangen-Nuremberg**, Inst. for Microwave Technology (Lehrstuhl für Hochfrequenztechnik), Cauerstr. 9, D-91058 Erlangen	Prof. Dr.-Ing. L.-P. Schmidt
5	**Germany**	Yes	**Karlsruhe Institute of Technology** (KIT), Inst. Hochfrequenztechnik und Elektronik, Kaiserstrasse 12, 76131 Karlsruhe	Prof. Th. Zwick
6	**Greece**	Yes	**National Technical University of Athens**, School of Elec. and Comput. Engin., Microw. and Fiber Optics Lab., Heroon Polytechniou 9, GR-15773, Zografou, Athens	Dr. N. L. Tsitsas
7	**Italy**	Yes	**University of Siena**, Department of Information Engineering, Via Roma 56, 53100 Siena	Prof. S. Maci
8	**Italy**	Yes	**University of Modena and Reggio Emilia,** Depart. of Information Engineer., Via Vignolese 905, 41100 Modena	Prof. A. Polemi
9	**Portugal**	Yes	**Instituto Superior Técnico** (IST), Instituto de Telecomunicações, Av. Rovisco Pais 1, 1049-001 Lisbon	Prof. C. A. Fernandes
10	**Switzerland**	Yes	**Ecole Polytechnique Fédérale de Lausanne**, Labor. d'Electromagnétisme et d'Acoustique, 1015 Lausanne	Prof. J. Mosig
11	**The Netherlands**	Yes	**Applied Electromagnetics Technical University of Delft**, Mekelweg 4, 2628 CD, Delft, The Netherlands	Prof. A. Neto
12	**Turkey**	Yes	**Bilkent University**, Department of Electrical and Electronics Engineering, Bilkent 06800, Ankara	Prof. A. Altintas
13	**UK**	Yes	**University of York**, Department of Electronics, Heslington, YO10 5DD York	Dr. J. Thornton
14	**UK**	Yes	**Queens University of Belfast**, Institute of Electronics Communications and IT, High Frequency Research Group, Queens Rd, Queens Island, Belfast BT3 9DT	Prof. V. Fusco
15	**Ukraine**	No	**National Academy of Science Ukraine** (NASU), Institute of Radiophysics and Electronics (IRE), ul. Proskury 12, Kharkov 61085	Prof. A. I. Nosich

Table 7. Institutions involved in the RNP.

At least, two additional private institutions might join our Network:

- TICRA, Denmark (contact name: Stig B. Sørensen, sbs@ticra.com, http://www.ticra.com),
- BAE SYSTEMS Advanced Technology Centre, Essex, CM2 8HN, UK (contact name: Gareth Lewis, gareth.lewis@baesystems.com).

Through publicity actions, the Steering Committee will ensure that the Network is open to any eligible public or private institutions (e.g. space agencies like CNES, DLR, ESA).

Global dimension

Proposals with a global dimension should include one additional page outlining the key persons in the global network(s), the scientific benefits expected from the collaboration and the status of the non-ESF request for funds**:**

N.A.

Section IV: *(not more than 3 A4 single pages in total)*

CVs

(Full coordinates and short *curriculum vitae* of the applicant(s) including 'contact person'. The list of the five most recent relevant publications of each applicant):

- **Coordinator of the Network:** Dr. Ronan SAULEAU
  IETR UMR CNRS 6164, University of Rennes 1
  35042 Rennes Cedex, France

  Email: Ronan.Sauleau@univ-rennes1.fr
  Tel: (+33) (0)2 23 23 56 76, Fax: (+33) (0)2 23 23 69 69
- **Contact person:** Dr. Ronan SAULEAU, www.ietr.org

Education

Ronan SAULEAU was born in 1972 (36 years-old), Rennes, France. He graduated in 1995 from "Institut National des Sciences Appliquées" (INSA), Rennes, France, in Electrical Engineering and Radiocommunications (*summa cum laude*) and simultaneously obtained his Master by Research in "Radiocommunications" (*summa cum laude*). He joined the "Ecole Normale Supérieure de Cachan" (ENS) in 1995 and received the "Agrégation" in 1996. He received the Doctoral degree in Signal Processing and Telecommunications from the University of Rennes 1 in Dec. 1999 (*summa cum laude*). Between Sept. 2000 and Oct. 2005, he was an Assistant Professor at the University of Rennes 1. He received the "Habilitation à Diriger des Recherches" in Nov. 2005 (*summa cum laude*). Since Nov. 2005, he has been an Associate Professor at the University of Rennes 1. He conducts his research work at the Institute of Electronics and Telecommunications, Rennes (IETR, UMR CNRS 6164).

Research activities

His main fields of interest are organized into two vertical and two horizontal activities.

The first two research areas include two major antenna categories, namely (1) 2-D / 3-D antennas at millimetre waves (micromachined antennas, planar antennas, integrated lens antennas, reconfigurable MEMS-based antennas), and (2) Periodic structures (Electromagnetic Band Gap materials, metamaterials, Fabry-Perot antennas, passive and reconfigurable periodic structures using active components and agile materials like liquid crystals).

The two horizontal activities are developed in order to strengthen and consolidate the two vertical activities; they include (1) numerical modelling (time-domain formulation, electromagnetic synthesis and optimisation), as well as (2) specific antenna technologies (micromachining techniques, thin film technologies and MEMS, reconfigurable materials, ultra-soft polymers). Dr. Sauleau also developed new multi-disciplinary research works at IETR in the following fields: (1) ICT and mathematics (volume integral equations), (2) ICT, Health Sciences and biophysics (biological effects of millimetre waves upon human cells, artificial biomembranes, cellular stress), (3) ICT and inorganic chemistry (reconfigurable ferroelectric microwave devices).

Since 2000, this research work has been conducted in various frameworks, namely (1) basic research to investigate new antenna concepts and technologies, (2) regional, national and European contracts and networks, (3) multi-lateral collaborations. He was involved in 22 research and industrial contracts (he was responsible of 11 of them) and participated in the writing of 39 contract reports (Thales Communications, Thales Alenia Space, CNES, TRW Autocruise, CEA Leti, France Telecom R&D). From 2001 to Sept. 2008, he co-supervised 7 PhD students, and he presently (co-)supervises 6 PhD students. Since 1998, he (co-)supervised 35 MSc students and participated in 17 PhD evaluation boards.

At the European and international level, Dr. Sauleau has been involved in several multi-lateral projects with Ukraine (projects: PHC Dnipro, PECO/NEI CNRS/NASU,

PICS/CNRS), Portugal (PHC Pessoa), Japan (Dr. Sauleau spent 6 months at NICT, Tokyo and had strong collaborations with NICT and LIMMS, Tokyo, leading to 22 joint publications), Finland (bilateral project with VTT and TKK). Since 2006, Dr. Sauleau has been coordinating the Research and Training Network “France – Ukraine – Croatia” on lens antennas. He also coordinates the ECO-NET project France – Georgia – Ukraine – Croatia” on focusing systems and photonics. Since 2004, Dr. Sauleau has been strongly involved in the Network of Excellence “Antenna Centre of Excellence” (ACE) (work package on “MM and sub-mm wave antennas & integrated antennas”; European School on Antennas). Dr Sauleau is also one of the two French representatives of COST-297 HAPCOS action. All these projects have led to the participation of the writing of 23 scientific cooperation reports.

Since end of 1998, Dr. Sauleau is the author or co-author of 1 book chapter, 53 journal papers, 8 invited talks in international and national conferences, 165 contributions in national and international conferences and workshops. He also holds 3 patents.

Dr. Sauleau was a member of various TPC (MRRS-05, MMET-06, EuCAP-06, EuCAP-07) and co-chaired several poster and oral sessions in national and international conferences (MRRS-05, MMET-06, CANUM-06, ConfTele-07, EuCAP-07, JNM-07). He organized or co-organized two one-day national workshops on millimetre wave antennas (2005) and metamaterials (2005), and one mini-symposium (CANMU-06); he participated in the organization of one international conference (ANTEM-05).

Dr. Sauleau received the 2004 ISAP conference Young Researcher Scientist Fellowship (Japan) and was the recipient of the first Young Researcher Prize in Britany, France in 2001 for his research work on gain-enhanced Fabry-Perot Antennas. Dr. Sauleau is a Senior Member of the IEEE since 2006. In Sept. 2007, he has been elevated as a member of the “Institut Universitaire de France” (IUF). He was awarded the Bronze Medal from CNRS in 2008.

Main administrative tasks

Dr. Sauleau was been nominated for 4 years at the National Committee of CNRS (Electronics, Optics, Micro/Nano-technlogies) in 2008. At the University of Rennes 1, Dr. Sauleau has been an elected member of the Faculty Council since 2001, a nominated member of the Commission for Industrial Exploitation since 2001, and a full or substitute member of various recruitment panels.

Fields of expertise in the area covered by the Network

1. Design and characterisation of mm-wave single- and double-material shaped lenses and domes for beam shaping applications in Ka-, Q-, V- and W-bands (indoor communications, automotive radar, communications with LEO and GEO satellites).
2. Analysis of lens antennas using (1) high-frequency techniques (Geometrical Optics (GO), Physical Optics (PO), GO/PO, PO/PO), (2) modal decomposition methods (plane waves spectrum and spherical modes expansion), and (3) full-wave methods (FDTD-2D, FDTD-3D, FDTD for Bodies of Revolution (BoR)).
3. Synthesis of lens antennas using GO techniques and partial differential equations.
4. Optimisation of lens antennas using local (gradient-type approaches), global (genetic algorithms) and hybrid (local + global) methods.

List of five most recent publications of the coordinator (R. Sauleau) in the field of research covered by the Network:

1. B. Barès, R. Sauleau, L. Le Coq, and K. Mahdjoubi, "A new accurate design method for millimeter-wave homogeneous dielectric substrate lens antennas of arbitrary shape", IEEE Trans. Antennas Propagat., vol. 53, no. 3, pp. 1069-1082, Mar. 2005.
2. R. Sauleau and B. Barès, "A complete procedure for the design and optimization of arbitrarily-shaped integrated lens antennas", IEEE Trans. Antennas Propagat., vol. 54, no. 4, pp. 1122-1133, Apr. 2006.

3. G. Godi, R. Sauleau, L. Le Coq, and D. Thouroude, "Design and optimization of three dimensional integrated lens antennas with genetic algorithm", IEEE Trans. Antennas Propagat., vol. 55, no. 3, pp. 770-775, Mar. 2007.
4. B. Barès and R. Sauleau, "Electrically-small shaped integrated lens antennas: a study of feasibility in Q-band", IEEE Trans. Antennas Propagat., vol. 55, no. 4, pp. 1038-1044, Apr. 2007.
5. A. V. Boriskin, G. Godi, R. Sauleau, and A. I. Nosich, "Small hemielliptic dielectric lens antenna analysis in 2-D: boundary integral equations vs. geometrical and physical optics", IEEE Trans. Antennas Propagat., vol. 56, no. 2, pp. 485-492, Feb. 2008.

Selected list of publications of the Partners of NEWFOCUS (publications in the area of NEWFOCUS)

Application-oriented contributions

Imaging systems and UWB systems

F. Gumbmann, H.P. Tran, J. Weinzierl, and L.-P. Schmidt, “Optimization of a Fast Scanning Millimetre-Wave Short Range SAR Imaging System”, Proc. EuRAD2007, Munich, Germany, pp. 24-27, Oct. 2007.

N. Llombart, A. Neto, G. Gerini, and P. De Maagt, "1D Scanning Arrays on Dense Dielectrics Using PCS-EBG Technology", IEEE Trans. Antennas Propagat., vol. 55, no. 1, Jan. 2007, Top downloaded (October 2007).

S. Bruni, A. Neto, and F. Marliani, “The UWB Leaky Lens Antenna", ", IEEE Trans. Antennas Propagat., vol. 57, no. 10, Oct. 2007.

Communications with HAPs and air vehicles

J. Thornton, “Wide-scanning Multi-layer Hemisphere Lens Antenna for Ka band”, IEE Proceedings Microwaves, Antennas and Propagation, vol. 153, pp 573-578, Dec. 2006.

Satellite communications

J. R. Costa, C. A. Fernandes, G. Godi, R. Sauleau, L. Le Coq, and H. Legay, “Compact Ka-band Lens Antennas for LEO Satellites”, IEEE Trans. Antennas Propagat., vol. 56, no. 5, pp. 1251-1258, May 2008.

Integrated transceivers and broadband/conformal feeds

T. Zwick, D. Liu, and B. Gaucher, "Broadband Planar Superstrate Antenna for Integrated Millimeter Wave Transceivers”, IEEE Trans. Antennas Propagat., vol. 54, no. 10, pp. 2790-2796, Oct. 2006.

J.R. Costa and C. A. Fernandes, "Broadband Slot Feed for Integrated Lens Antennas", IEEE Antennas Wireless Propag. Lett., vol. 6, pp. 396-400, Sep. 2007.

Z.Sipus, S. Skokic, M. Bosiljevac, and N. Burum, “Study of Mutual Coupling Between Circular Stacked-Patch Antennas on a Sphere”, IEEE Trans. Antennas Propagat., vol. 56, pp.1834-1844, Jul. 2008.

Automotive radars and front-ends

L. Xue and V.F. Fusco, “24GHz Automotive Radar Planar Lunberg Lens”, IET Proc. Micro., Ant., and Prop., vol.1, no.3, pp 624-628, Apr. 2007.

Electromagnetic theory and computational methods

N. Tsitsas, N. Uzunoglu, and D. Kaklamani, “Diffraction of Plane Waves Incident on A Grated Dielectric Slab: An Entire Domain Integral Equation Analysis”, *Radio Science*, vol. 42, RS6S22, 2007 (26 pages).

S. Maci, A. Toccafondi, A. Polemi, and L.B. Felsen, “High-Frequency Green's Function for a Semi-Infinite Array of Electric Dipoles on a Grounded Slab. Part II: Spatial Domain Parameterization”, IEEE Trans. Antennas Propagat., vol. 53, pp. 1364-1376, 2005.

L.B. Felsen, S. Maci, A. Polemi, and A. Toccafondi, “High-Frequency Green's Function for a Semi-Infinite Array of Electric Dipoles on a Grounded Slab. Part III: Phase-Matched Wave Interactions and Numerical Results”, IEEE Trans. Antennas Propagat., vol. 53, pp. 1663-1671, 2005.

A.V. Boriskin, A. Rolland, R. Sauleau, and A.I. Nosich, "Assessment of FDTD Accuracy in the Compact Hemielliptic Dielectric Lens Antenna Analysis", IEEE Trans. Antennas Propagat., vol. 56, no. 3, pp. 758-764, Mar. 2008.

A. I. Nosich, “The Method of Analytical Regularization in Wave-Scattering and Eigenvalue Problems: Foundations and Review of Solutions”, IEEE Antennas Propag. Mag, vol. 41, no. 3, pp. 34-49, 1999.

T. Oguzer and A. Altintas, “Analysis of the Nonconcentric Reflector Antenna in Radome System by the Iterative Reflector Antenna and Radome Interaction”, J. of EM Wave and Applications (JEMWA), vol. 21, pp. 57-70, 2007.

A.P. Pavacic, D. Llorens del Rio, J.R. Mosig, and G.V. Eleftheriades, “Three-Dimensional Ray-Tracing to Model Internal Reflections in Off-Axis Lens Antennas”, IEEE Trans. Antennas Propagat., vol. 54, pp. 604-612, 2006.

Advanced measurement techniques

A. Lönnqvist, T. Koskinen, J. Häkli, J. Säily, J. Ala-Laurinaho, J. Mallat, V. Viikari, J. Tuovinen, and A. V. Räisänen, “Hologram-based Compact Range for Submillimeter Wave Antenna Testing”, IEEE Trans. Antennas Propagat., vol. 53, no. 10, pp. 3151-3159, 2005.

A. Lönnqvist, J. Mallat, and A. V. Räisänen, "Phase Hologram Based Compact RCS Test Range at 310 GHz for Scale Models," IEEE Trans. on Microwave Theory and Tech., vol. 54, no. 6, part 1, pp. 2391- 2397, Jun. 2006.