EUROPEAN SCIENCE FOUNDATION
SETTING SCIENCE AGENDAS FOR EUROPE

EUROCORES Programme
European Collaborative Research

Computational Mathematics as a driving force for innovation in Europe (EuroCompMath)

DRAFT Call for Outline Proposals

What is EUROCORES?

The ESF European Collaborative Research (EUROCORES) Programmes offer a flexible framework for researchers in Europe to work on questions which are best addressed in large-scale collaborative research programmes.

The EUROCORES Programmes allow excellent researchers in the various participating countries to collaborate in research projects 'at the bench'. They also allow, when appropriate, colleagues in non-European countries, for example the US, to participate. The Programmes encourage and anticipate networking and collaboration between researchers in order to achieve synthesis of scientific results across the programme, to connect with related programmes, and to disseminate findings.

The EUROCORES Programmes allow national research funding organisations in Europe and beyond to support top-class research in and across all scientific areas, by matching their strategic priorities with the needs articulated by the scientific community.

Final funding decisions on the projects and the research funding remain with the national funding organisations, based on a single international peer review process operated by ESF. Financed by the participating national Funding Organisations, ESF also provides support for networking between the researchers and for the scientific synthesis of research results and their dissemination. In this way, the EUROCORES Scheme complements the EC Framework Programme and other collaborative funding schemes at European level.

For further information see:
http://www.esf.org/eurocores

Computational Mathematics as a driving force for innovation in Europe (EuroCompMath)

Following agreement with XX funding organisations in *Country A, Country B, Country C, Country D, Country E, Country F, Country G, Country H, Country I, Country J, Country K, Country L, Country M, Country N, Country O and Country P* the European Science Foundation is launching a Call for Outline Proposals for Collaborative Research Projects (CRPs) to be undertaken within the EUROCORES Programme EuroCompMath. The Programme aims to support high quality multidisciplinary collaborative research in Europe, with involvement of leading scientists from outside Europe, when appropriate.

The research phase of EuroCompMath will run for three years [(1)] and includes national research funding as well as support for networking and dissemination activities. The research grants are provided directly to the eligible and successful Principal Investigators by their respective national funding organisations. The networking and dissemination support, also financed by the national organisations, is centrally managed by the ESF.

Outline Proposals are to be submitted by xth February 2011. It is expected that Full Proposals will be invited by xth March 2011 with xx May 2011 as expected deadline for submission.

A Programme-specific website can be consulted for the latest updates at
http://www.esf.org/eurocompmath

Background and objectives

With computers becoming ever more powerful, *Mathematical Modelling* and *Computational Mathematics* have become increasingly important. As a cross-sectional science, Computational Mathematics acts horizontally in a world of vertically oriented sciences. It forms bridges between fundamental and applied research and has become a vital link between the traditional branches of theory and laboratory experiments.

Entire technologically and economically important industrial branches such as the automotive industry, aviation, space technology, semiconductor technology, and optoelectronics, to name but a few, rely heavily on Computational Mathematics. Simulation and optimisation based on mathematical models are not just powerful research tools; they form extremely important links in the innovation chain

[1] The formal duration of EUROCORES programmes is three years; however, individual researchers will apply to the national or other funding organisations under their respective rules, which may allow for more than three years' funding. No networking and coordination support will be available outside the formal duration of the programme.

Many phenomena and processes in nature, technology, and economy can be accurately described by mathematical models, which in turn form the basis for efficient and precise computer simulations. Modern techniques of Computational Mathematics help us to

- avoid costly, energy-consuming, and environment-polluting experiments (simulation as "virtual laboratory");
- gain insights on space and time scales that are not accessible to measurements (simulation as "high resolution microscope");
- quantify uncertainty in numerical predictions if experiments are dangerous or impossible (e.g., in medicine, climate research and environmental sciences);
- shorten the cycles and reduce the costs for the development of innovative technologies;
- improve the efficiency of production processes and the quality of industrial products, including green industries;
- support the interpretation of experimental results (e.g., selection between different possible hypotheses).

In many cases, the mathematical models behind the above mentioned computer simulations in applied sciences are based on partial differential equations (PDEs) or coupled systems of PDEs with constraints, which reflect the multi-physics and the complex nature of these problems. The size of the linear algebraic systems arising upon linearisation and discretisation is very often of the order of 10^6 - 10^9 unknowns. In view of their sheer computational complexity, such tasks cannot be successfully tackled without a simultaneous application of specialised robust solution techniques, high performance algorithms, and software tools for highly advanced computer facilities, including those based on parallel and distributed processing. If we are to finally solve challenging problems posed by a diversity of modern applications, then *the development and mathematical foundation of numerical and symbolic algorithms for solving complex PDE problems are of utmost importance*,

The solution of complex PDE systems with methods from Computational Mathematics is a multidisciplinary task, which can only be tackled successfully on an international scale. It is the mission of the EuroCompMath Programme to bring together experts working in the fields of Applied Analysis and Numerical Mathematics, Statistics and Stochastics, Direct and Inverse Field Problems, Simulation and Optimisation, Numerical and Symbolic Computing in order to address the challenges of Computational Mathematics.

Research work in EuroCompMath will be primarily *horizontal* in character and is not a priori targeted at a specific application. In fact, the methods of Computational Mathematics to be developed in this EUROCORES programme mainly aim at providing the mathematical basis and computational machinery necessary for efficient and reliable solution of challenging problems in several of the vertical research lines. As an example, let us only mention the classical multigrid and the more recent multiscale methods, in connection with adaptive strategies based on a posteriori error estimates, whose development started at least one decade ago, and which nowadays provide a powerful computational machinery for many challenging problems in quite different fields.

The main objectives of the EuroCompMath Programme are the development and mathematical foundation of new robust, fast, and accurate numerical and symbolic algorithms for solving complex PDE problems, in particular, for coupled-field problems arising in multi-physics, or variational inequalities, and the development of efficient solvers that are able to quantify data and solution uncertainty. In this connection, the following subjects will have to be addressed:

- Multiple scales in time and space;
- Discontinuity and singularity of data and solutions;
- Combination of concepts of adaptivity (models, space-time, numerical methods);
- Exploitation of modern hardware technologies;
- Numerical analysis of newly developed methods;
- Computational complexity and scalability of the algorithms.

Scientific goals

The main *scientific goal* of the EuroCompMath programme is the mathematical foundation and development of the computational machinery for certain general classes of PDE problems arising from challenging applications. Proposals for both more *method-oriented* CRPs and more *problem-oriented* CRPs are expected and encouraged.

In the method-oriented CRPs, experts from Numerical Analysis and Numerical Linear Algebra will join forces with experts working algorithmically, with a focus on the efficient implementation of the developed algorithms on different computer architectures. The problem-oriented CRPs should bring together people working in Mathematical Modelling, Analysis, Numerical Analysis, PDE-constrained Optimisation and Inverse Problems. A close cooperation between the method-oriented CRPs and the more problem-oriented CRPs will have to be maintained.

In the short term, new mathematically well-founded computational methods, developed within the EUROCORES programme and thoroughly tested for certain classes of PDE problems, should provide a new computational machinery from which Computational Sciences as a whole will benefit. In the long term, these new computational methods should make a marked impact on the next generation of commercial software.

Concrete milestones will have to be defined for each individual Collaborative Research Project. The overall schedule of the programme as a whole is marked by the following milestones:

1. *Collaboration Plan for EuroCompMath (upon kick-off of the programme).*
   In order to fully exploit the large potential for synergies, a detailed collaboration plan will be elaborated by all CRP leaders after the final selection of the CRPs, including the schedule for conferences, workshops, schools, dissemination events and exchange visits.
2. *Setup of the Collaborative Research Projects (upon kick-off of the programme)*.
   In EuroCompMath, scientists will cooperate on two scales. On the smaller scale, within the CRPs, different groups will co-operate in well focused research topics. For this co-operation, a careful setup of these projects is mandatory. This will be supported by a kick-off meeting of every CRP.
3. *Availability of new mathematical methods for the application in problem-oriented Collaborative Research Projects (after approx. 18 months).*
   Mathematical methods, which will be needed in (possibly different) problem-oriented CRPs, have to be provided at an appropriate time, as described in the Collaboration Plan (milestone 1).
4. *Availability of new mathematical methods for direct PDE problems (after approx. 18 months).*
   As in milestone 3, the work on specific inverse and optimisation problems will be based on new methods and solvers for direct PDE problems, which have to be provided when needed.
5. *Completion of the programme (after 36 months)*.

At the end of the EuroCompMath programme, a computational machinery will be developed as described. If applicable, software implementations of new methods into scientific packages will be done. The final international scientific conference, including all the CRPs' scientists and further leading scientists from all over the world, will be held.

Research topics

The classes of PDE problems to be addressed by the EuroCompMath Collaborative Research Project proposals are characterised by specific features and properties that are not present in standard applications. Typical for practical applications is the occurrence of, e.g., complex geometries, instabilities, bifurcations, free boundaries, phase transitions, thin layers, mesh and coefficient anisotropies, hysteresis effects, discontinuous coefficient functions and jumping boundary conditions. The following 10 classes of problems have been identified in this Call.

Problem Class 1
Coupled-field (PDE) problems arising from multi-physics that involve multiple inherent space and/or time scales and "bad" small parameters that cause singularities, boundary layers, turbulence, and so on. Problems of this type can be found in a number of different applications, from crack propagation to traffic modelling to the spread of tumors. One important subclass of such problems can be called

- ***"MAXWELL++".***

It comprises systems of PDEs in which Maxwell's equations for the electromagnetic field are coupled to other physical field equations such as the balance laws of energy, momentum, and/or phase fields. Typical applications include magnetic induction in the hardening of steel workpieces, the use of travelling magnetic fields in the growth of bulk single crystals from the melt, as well as laser technology and optoelectronics. Magnetomechanics and magnetohydromechanics are certainly more classical applications in which the electromagnetic field interacts with solid mechanical and fluid fields, respectively. Fast and precise numerical magnetomechanical and piezoelectrical solvers play a decisive role in the numerical simulation of mechatronic sensors and actuators, which are the smart parts in many products.

Problem Class 2
Of similar significance is the simulation of

- ***reactive and bio-convective flows.***

This topic is of great interest for applications in chemical engineering, environmental engineering, pharmacy, and other fields. These flows are modelled by strongly coupled systems of PDEs representing conservation laws that describe the flow of the fluid, the movement of solutes or particles carried with the flow and their interaction with the flow and between each other. Wide ranges of scales in space and time, induced, e.g., by differing speeds of intermediate reactions, turbulence, fluid instabilities, multiple phases, couplings with porous media, and moving boundaries are typical for these systems and pose serious mathematical and numerical challenges.

Problem Class 3
Based on the properties of interfaces between different organic polymers,

- ***organic photovoltaic devices***

pose multi-scale problems in modelling the (still lacking) efficiency of this potentially very cheap solar technology. Efficient models for the interfaces in union with drift-diffusion type bulk modelling will serve to identify high efficiency interface geometries and present fast (forward) models for applying inverse methods.

Problem Class 4
Another important class of PDE problems are

- ***PDE problems involving variational inequalities.***

Such problems naturally occur in free boundary problems, e.g., as models for phase transitions (liquid-solid, liquid-gas, solid-solid), elastoplastic behaviour of structures, smart materials, or simply for problems with obstacles. Another type of such problems is obtained by the first-order necessary (Karush-Kuhn-Tucker) conditions of optimality for optimisation problems with PDE constraints, including, e.g., optimal control problems governed by PDE systems, topology and material optimisation problems. Another important nonstandard application area for variational inequalities, which leaves considerable space for the development of efficient numerical schemes, are portfolio optimisation problems taking into account trading costs.

Problem Class 5
The importance of the development of efficient numerical techniques for solving

- ***large scale non-differentiable optimisation with PDE constraints***

has been recognised for some time. However, systematic research on this topic on a broader basis has started only recently. Such methods are required, for example, in mathematical imaging in the context of sparsity constraints. Non-differentiable cost functionals also provide one of the most promising mathematical formulations for optimal observer and actuator placement in optimal control. Finally, in inverse problems robust fit-to-data criteria are typically based on non-differentiable functionals. The challenge lies in the development of methods that are faster than linear, in spite of the fact that classical Newton methods are not applicable. From the point of view of optimisation, semi-smooth Newton methods will provide the theoretical basis for new developments that must be merged with appropriate discretisation techniques for the PDEs and, possibly in a problem-dependent manner, regularisation methods.

Problem Class 6
The identification of parameters in, e.g., PDEs requires the development of

- ***efficient methods for the solution of large scale inverse problems.***

Many medical or technical applications are modelled by partial differential equations. A common task is the identification of a parameter in the PDE system from, e.g., noisy boundary measurements. Often the search for a parameter does not continuously depend on the measured data, and regularisation methods have to be used. In order to preserve specific properties of the solution, problem adapted regularisation methods have to be developed, which in particular includes the development of stable inversion formulas for applications of interest. In addition, further development of regularisation methods is required. Of interest are methods based on Tikhonov type functionals with non-differentiable misfit or penalty term. Fast iterative techniques are needed for the minimisation of the functionals as well as rules for the choice of the regularisation parameter.

Problem Class 7
In the context of mathematical modelling and system sciences,

- ***reduced order methods***

play an important role. In fact, many engineering applications require accurate and reliable quantitative information about quantities of interest, which can be "smaller" than knowledge of the complete set of state variables at the solution of the PDE system. This information of the quantity of interest, however, is required repeatedly for different set points of parameter configurations describing the model. Alternatively, one of the essential features of reduced order methods is the determination of those parameters and their values which contribute significantly to a PDE based model.
Currently, significant advances are being made in the development of concepts that enable efficient description of the input-output behaviour of PDE based models with the help of reduced basis techniques. It is of significant interest to further these developments towards large scale applications, as for instance in the context of reaction diffusion systems involving a multitude of reactions. In the framework of optimal control, especially control of flow phenomena, order reduction is typically based on proper orthogonal decomposition (POD) which, in contrast to balanced truncation also applies for nonlinear systems. The order reduction based on POD for optimal control of diffusion type phenomena is stunning. It is currently the only concept available for the solution of closed loop optimal control problems based on the Hamilton-Jacobi-Bellman equations. First feasibility studies for this concept have recently been published. The research

should still acquire the necessary momentum for an in-depth investigation.

Problem Class 8

A prerequisite for the application of the numerical techniques described above is the

- ***mesh generation,***

i.e., the subdivision of the spatial domain in polygonal or polyhedral elements, called finite elements. Depending on the numerical methods used, different challenges for this subdivision have to be met. Automatic mesh generation tools are already broadly used and are they able to generate isotropic meshes from consistent geometry descriptions. However, several challenges have not yet been met by this kind of tools. Optimal meshes, e.g., for flow problems demand aligned anisotropic elements. Automatic generation and adaptation in this case are still in their infancy. Another challenge is associated with the fact that in many cases geometry descriptions generated from typical CAD tools do not meet the consistency criteria for successful mesh generation. Heuristic approaches are widely used in this field, while mathematically more rigorous approaches have the potential to be more successful in the long term.

Problem Class 9

Together with these instruments it is important to analyse the behaviour of and improve the performances of several

- ***new discretisation methodologies***

which have been introduced (or studied) recently. In general, they aim at the improvement of performance of more classical discretisation methods, such as Finite Differences of Finite Elements, by adding features that might be very important in several applications. These are most often due to the need for discrete solutions that satisfy *exactly* some important physical properties, like *conservation* (of mass in fluid mechanics, of charge in electromagnetic problems, etc.), *equilibrium* (in continuum mechanics) or *incompressibility* (for fluids and also in some problems of continuum mechanics). Some other methods aim at reproducing exactly the *shape* of the object as it comes out of a CAD (Computer Aided Design) code.

Several variants of Finite Element Methods do already satisfy some of these requirements (as Finite Volumes or Mixed Finite Elements, although only on rather simple element geometries, for conservation, or equilibrium, or incompressibility). Other methods are more recent, as the Mimetic Finite Differences (that reproduce the good properties of Finite Volumes and Mixed Finite Elements on more complicated geometries) or Isogeometric Methods that allow a perfect reproduction of shapes that come out of CAD programs.

Other techniques, like Discontinuous Galerkin Methods are older, but found new fields of application only in recent times. The studies of the stability and accuracy properties of these methods have received a lot of attention during the last five years, but the computational aspects still require a much more careful investigation.

Problem Class 10

Incompleteness or stochasticity in data entails the need for accounting for uncertainty in predictive numerical simulations. Therefore, in future development of numerical simulations it will be necessary to account for the

- ***capability of uncertainty quantification,***

i.e., the capability to account for random input data (such as loadings and source terms, coefficients, fluxes, etc.). This can be done in a straightforward, nonintrusive fashion by Monte Carlo (MC) simulations of random data and the use of existing, deterministic simulation software. Due to the slow convergence of MC simulations, this approach imposes tight limits on predictive simulations. More efficient computational methods should focus on partial redevelopment of deterministic solvers which aim at directly approximating the probability densities of the random solutions. This latter approach requires, as a rule, new mathematical formulations, partial or complete refactoring of simulation codes and massively parallel computing hardware. Within the present Call, this item impinges on all areas, but, in particular, on Problem Classes 1, 3, 4 and 5.

Guidelines for applications

(Outline and Full Proposals)

This Call for Proposals is for Outline Proposals for Collaborative Research Projects (CRP). Proposers should be individual scientists (or research groups represented by individual scientists) who are eligible for funding from a national funding organisation participating in the EUROCORES Programme EuroCompMath.

Scientists or groups not applying for or not eligible to apply for funding from such an organisation can be associated to a proposal when their scientific added value can be demonstrated. Participation of Associate Partners in a project must be fully self-supporting and will not be financially sponsored by the participating funding organisations.

Proposals are only eligible if they fulfil all of the following **criteria**:

- Proposals must involve, as a minimum, three eligible Principle Investigators (PIs) from **three different countries.**
- A maximum of 50% of the total number of Individual Projects (IPs) in a Collaborative Research Project (CRP) can come from one country.
- Proposals must involve more PIs than Associated Partners (APs).

Applications should envisage three years of research. Taking into account the two-stage proposal selection and approval process (described below), the successful projects are expected to begin their research phase activities during **March** - **June 2012**.

Online submission of applications

Outline and Full Proposals will be submitted online. Applicants should follow the proposal structure as indicated in the application template for Outline Proposals available on the Programme website at: **http://www.esf.org/eurocompmath**.

Links to information on national funding eligibility and requirements as well as to a EUROCORES Glossary and Frequently Asked Questions (FAQs) are available on the Programme website.

Prior to submitting Outline Proposals, all applicants <u>must</u> contact their national funding organisations in order to verify eligibility and to ensure compliance with their national grant requirements and regulations. The list of participating organisations and their nominated contact persons is included on the last page of this document.

At the time of the online submission of the Outline Proposal, the Project Leader will be asked to confirm on behalf of the consortium that all the Principal Investigators in the CRP have consulted their national funding organisations and are eligible for funding from these organisations.

Outline Proposals

Outline Proposals are invited by xth February 2011.

Outline Proposals will be examined by the participating funding organisations for formal eligibility. Therefore, it is crucial that all applicants requesting funding contact their national funding organisation prior to submitting their proposals.
In compliance with the rules and regulations of the participating national funding organisations, the requested funds under the EUROCORES Programme EuroCompMath may include salaries for scientific and technical staff, equipment, travel costs and consumables within the project. The amounts requested from each funding organisation participating in the call must be clearly specified. National policies may also require the proposal to contain specific additional information. Applicants should be aware that the participating funding organisations can make adjustments to the requested funds in order to bring these in line with their normal grant regulations and standards.

As described below, applications will be reviewed according to specific assessment criteria in a two-stage procedure. The goal is to select scientifically excellent proposals which fit well within the scope of the programme and have significant potential to add value to its achievements.

At the outline stage, the Review Panel will select proposals based on the following criteria:

- Relevance to the Call for Proposals
- Novelty and originality
- European added value (scientific)
- Qualifications of the applicants

An Outline Proposal must comprise:

- A short description of the CRP (max. 1200 words, including objectives, milestones, methodologies (e.g. experiments and fieldwork);
  - Short description of how (and why) the partners contributing to the CRP will work together and how their contributions will be integrated;
- Short CVs of Project Leader (PL), all PIs and Associate Partners, including five most relevant publications (max. one page each);
- Estimated budget (consistent with the rules of relevant national funding organisation), tabulated according to a provided template.

Associated Partners (APs) are also considered part of a CRP and will be assessed as such at both the Outline and Full Proposal stage.

It will be assumed that arrangements for the handling of Intellectual Property Rights (IPR) will be in place within projects, following the applicable national legislation and national funding organisation's regulations. Applicants are strongly urged to have such arrangements in place, covering all research groups (including any associated groups) before the start of the projects. It is expected that the results obtained by the projects supported under this EUROCORES Programme will be placed in the public domain, through standard scientific dissemination activities.
It is also expected that compliance with all other relevant national or international regulations on research (for example ethics) will have been affirmed before funding is granted. It is the responsibility of applicants to clarify any such matters (if applicable) with their national contact points.

Full Proposals

Full Proposals will be invited following the recommendations of the Review Panel. The deadline for Full Proposals will be announced later, but is expected to be around xxth May, 2011.

Please note that only applicants who have submitted an Outline Proposal can submit a Full Proposal.

For the Full Collaborative Research Project (CRP) Proposals, the most important selection criterion is "scientific quality". Other criteria include interdisciplinarity (according to the scope of the call), qualifications of the applicants, level of integration and collaboration, feasibility and appropriateness of methodologies, European added value, relation to other projects (complementarities versus risk of overlaps and double-funding) and suitability of the requested budget.

The Full Proposals will be assessed by at least three independent external expert referees selected by the ESF. The expert referees are selected from a pool of scientists suggested by the participating funding organisations, the Review Panel and the ESF office. The names of all referees used in the international peer review of EUROCORES programmes, together with the names of those who have contributed to the peer review process in other ESF instruments, will be published on the ESF website once in a given year.
The referee reports will be made available (anonymously) to the applicants for their information and if necessary for their comments and clarifications. The Review Panel will rank all Full Proposals based on the assessment of the Full Proposal, the anonymous referee reports and the applicant's responses to these.
The Review Panel will create a rank-ordered list of the strongest Full Proposals and will subsequently make recommendations to the Management Committee for the funding of these proposals. The Management Committee assigned to each programme comprises representatives of all the participating funding organisations.

The actual granting of the funds to the Individual Projects will be based on the Review Panel's ranked list. The funding cut-off will be determined based on the total amount of funds available in each participating Funding Organisation and how the Individual Projects figure on the list. The use of funds in a project will be subject to the national requirements and regulations of each participating Funding Organisation.

Full proposals must include sound and well-argued scientific cases both at the level of the consortium's collective objectives and in terms of the expected contributions of each of the Individual Projects in the consortium. Full Proposals must also include a list of all participants and their contact information and shorts CVs, detailed tabulated budgets for the whole CRP and for each project within it. Full Proposals could include other necessary supporting information. A coherent and common scientific case must be made throughout the proposal to demonstrate a collective and collaborative aim and for scientific synergy and integration of multinational expertise. In addition, the amount requested from each national funding organisation has to be clearly and separately specified. Detailed instructions on requirements and how to complete the application forms will be made available when inviting Full Proposals.

The **Project Leader** (PL) will be the main point of contact between the ESF and the CRP for the whole duration of the project. He/she will be responsible for the flow of information and communication between the ESF and all the participants in the CRP. The PL will represent the Collaborative Research Project in relation to its participation in programme activities and for the fulfilment of reporting requirements for the CRP as a whole and for the contributions of the individual Principal Investigators in the CRP.

In addition to their normal scientific and collaborative activities within the CRP, all **Principal Investigators** will be responsible for dealing with the requirements concerning the contributions of their national funding organisation, and for supporting the Project Leader in the overall progress of the CRP, including organising and participating in networking activities and in the fulfilment of reporting requirements.

Programme Structure and Management

Programme Structure

The overall responsibility for the governance of each individual EUROCORES programme lies with a *Management Committee*, whose members include one representative from each participating funding organisation in the programme (usually a senior science manager), together with an ESF representative.

Proposal assessment and selection are the responsibility of an international, independent *Review Panel*. The members of this panel are leading scientists, appointed by the ESF following suggestions from participating Funding Organisations. The membership of the Review Panel will be available on the Programme website for information. The Review Panel is also expected to monitor the overall scientific progress of the programme.

The Scientific Committee is formed by the Project Leaders of all funded CRPs and will be responsible for the overall scientific progress of the programme, including for the preparation of a work plan for the overall programme activities, including networking and dissemination. The Scientific Committee will also advise and support the EUROCORES Programme Coordinator in the coordination of the programme.

Programme Networking

Networking activities are designed to strengthen the scientific objectives of the EUROCORES Programme by promoting coherence and synergy in the activities of the scientific community involved. This will help to produce the European added value which is a main objective of all EUROCORES Programmes.

Networking and collaboration within EUROCORES Programmes take place at two levels:

1. Between the various Individual Projects within each Collaborative Research Project (CRP) (intra-CRP activities), and;
2. Between the funded CRPs in the programme (cross-CRP activities).

The intra-CRP activities must be supported through the individual research grants the participants receive from the national funding organisations in the given CRP.

The cross-CRP activities are centrally funded by the ESF through contributions from the participating organisations to the EUROCORES Programme.

The intra-CRP collaboration is motivated by the nature of the CRP's research objectives, i.e. by the scope and the complexity of the questions it deals with. In a CRP, the participating groups have the opportunity to gather the required critical mass to successfully address the objectives and challenges of their project.

The cross-CRP networking and collaboration is inspired by the aims and the nature of the EUROCORES Programme as a whole. The themes of EUROCORES Programmes are selected because they demonstrate a clear need for collaboration in the proposed field. The funded CRPs will collectively establish and streamline this new collaboration. To this end, the CRPs will engage the programme participants and, when of clear benefit, colleagues from outside the programme in joint activities such as:

- Programme-wide meetings or conferences;
- Working group meetings for the exchange of information and results across the CRPs;
- Joint scientific meetings or summer schools;
- Short term visits;
- Development and delivery of joint training programmes;
- Seminars, workshops, symposia, invited sessions either stand-alone or as part of other larger events;
- Common web-facilities and publications.

Through active participation of scientists in the above mentioned activities, not only can existing collaborations be enhanced, but new and strategic partnership opportunities may also be identified.

Furthermore, these activities may provide opportunities to explore aspects of the programme which are not covered by the funded research projects.

The integrating activities between the CRPs should help to strengthen the field by building coherence within the existing and emerging research communities and will serve as platforms for the dissemination and outreach of the research conducted in the programme.

Project members are expected to participate annually in at least one cross-CRP activity.

When submitting your proposal, please note that the costs for networking within your CRP should be included in your proposal as part of the costs of meetings, travel and subsistence. Funds for networking between the CRPs will be centrally managed by the ESF through contributions from the participating funding organisations.

Programme evaluation

A mid-term evaluation involving the Review Panel will assess the overall progress of the Programme. The Review Panel may also comment on the CRPs' work plan in relation to the objectives of the overall Programme. A final evaluation at the end of the Programme will assess the overall achievements of the whole EUROCORES Programme.

Contacts in the participating organisations

As it is currently not known which Funding Organisations will support this programme, please contact your National Funding Organisation or Research Council to inquire about this programme.

ESF Contact:

Dr. Aigars EKERS
EUROCORES Programme Coordinator
for EuroCompMath
European Science Foundation
1 quai Lezay-Marnesia
67080 Strasbourg
France
Tel: 0033-388767176
Fax: 0033-388370532
Email: aekers@esf.org
eurocompmath@esf.org

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[1] The European Science Foundation (ESF) provides a platform for its Member Organisations to advance European research and explore new directions for research at the European level.
Established in 1974 as an independent non-governmental organisation, the ESF currently serves 79 Member Organisations across 30 countries.