



VISION RICAM 2020

The current mission statement of the Johann Radon Institute for Computational and Applied Mathematics (RICAM) is as follows:

The Johann Radon Institute for Computational and Applied Mathematics

1. does basic research in computational and applied mathematics according to highest international standards
2. obtains the motivation for its research topics also from challenges in other scientific fields and industry
3. emphasizes interdisciplinary cooperation between its workgroups and with institutions with similar scope and universities world-wide
4. cooperates with other disciplines in the framework of special semesters on topics of major current interest
5. wishes to attract gifted PostDocs from all over the world and to provide an environment preparing them for international careers in academia or industry
6. cooperates with universities by involving PhD-students into its research projects
7. promotes, through its work and reports about it, the role of mathematics in science, industry and society

This statement was from the beginning considered as remaining valid in the long run and will also be essential for the future development of the Institute. We relate our Vision 2020 to the individual points of the mission statement.

1. RICAM does basic research in Computational and Applied Mathematics according to highest international standards

Basic research in Computational and Applied Mathematics will remain the key mission of RICAM; as today, the backbone of the Institute will be about ten working groups in subfields of Computational and Applied Mathematics which can be considered as central to this area. Those groups will each, in the average, employ five post-doctoral researchers from basic funds and will bring in third party funds, mainly for doctoral students. The aim is to have, on the average, at least 33 % of the groups' total budgets from outside funds to be obtained after competitive international refereeing, e. g. from the Austrian National Science Foundation FWF.

The requirements for each group will, as today, be

- the ability to do research in their respective fields at the international forefront of research
- the availability of group leaders willing and able to put substantial effort into scientific leadership of the group
- the potential of interaction between the groups and with the outside world (both within and outside mathematics)

The group members to be funded from the basic funds of RICAM will be mainly PostDocs and will be internationally recruited. The normal employment model will be an initial period of three years and, after scientific success and (normally) after having brought in some third party funding for doctoral students, another three years. Tenure will remain a quite exceptional case.

According to our experience and our expectations of the development of Computational and Applied Mathematics, the following groups will fulfill these criteria also in 2020 and will therefore still exist, maybe with slightly different scientific emphasis compared to today:

- **Analysis of Partial Differential Equations**
(Current group leaders: Prof. Peter Markowich, Vienna/Cambridge, Doz. Dr. Massimo Fornasier, Linz)
- **Computational Mathematics for Direct Field Problems**
(Current group leader: Prof. Ulrich Langer, Linz)
- **Inverse Problems**
(Current group leader: Prof. Heinz W. Engl, Linz/Vienna)
- **Mathematical Imaging**
(Current group leader: Prof. Otmar Scherzer, Vienna)
- **Mathematical Methods in Molecular and Systems Biology**
(Current group leaders: Dr. Philipp Kügler, Linz/Vienna, Prof. Christian Schmeiser, Vienna)
- **Optimization and Optimal Control**
(Current group leader: Prof. Karl Kunisch, Graz)
- **Symbolic Computation**
(Current group leader: Prof. Josef Schicho, Linz)

The recent evaluation of the Institute confirmed that all these groups fulfill the requirements mentioned above. Cooperation between these groups documented by publications is intensive and forms a nearly complete graph. Various cooperations between, on the one hand, symbolic and analytical/numerical methods and, on the other hand, direct and inverse methods are and will remain to be a key characteristic of RICAM.

Key areas of Computational and Applied Mathematics that are currently still missing and would be desirable to be established up to 2020 are **Stochastics** and **Discrete Mathematics**. Currently, some members of the Institute work in these areas, but strong groups could not yet be established, mainly since appropriate group leaders were not available.

In addition to these more stable groups to be established with a longer perspective, there should also be **junior groups** with a flexible structure. They should be established for about four years, based on international advertisements and be equipped with a position for a group leader and one additional PostDoc position and be expected to bring in third party funding for doctoral students. The concrete sub-areas of Computational and Applied Mathematics where such groups will be established should be mainly determined by the availability of appropriate junior group leaders and scientific links to at least one of the long-term groups. Such junior groups could also be nuclei for new long-term groups. This strategy could also help in filling the current gaps in Stochastics and/or Discrete Mathematics. The establishment of junior groups has been strongly supported by the last evaluation.

2. RICAM obtains the motivation for its research topics also from challenges in other scientific fields and industry

The research in RICAM so far has certainly obtained motivation from other scientific fields, e.g., in the framework of the Special Semesters (to be mentioned below) and also from industry, and the establishment of the group “Mathematical Methods in Molecular and Systems Biology” also shows that RICAM actively contributes to the needs of other scientific disciplines. A further important goal is also to contribute to the application of mathematical methods in industry by establishing a **Transfer Group**: it has been a long-standing strength of mathematics in Linz that both basic research and cooperation with industry have been done on a high level according to international standards. In order to keep sufficient independence of RICAM, direct cooperations with industry will usually not be done on a contractual basis with RICAM, but in cooperation with the Industrial Mathematics Competence Center (IMCC) via the RICAM Transfer Group. RICAM is already a scientific partner of IMCC, this cooperation should be strengthened and expanded.

3. RICAM emphasizes interdisciplinary cooperation between its workgroups and with institutions with similar scope and universities world-wide

The original core of cooperations between working groups was formed by the FWF-supported SFB “Numerical and Symbolic Computation”, which was very successful and also laid the groundwork for the establishment of RICAM. Another cooperation which already was initiated in this SFB was the one between direct and inverse problems. These cooperations will continue and will be strengthened and expanded. E.g., the scientific boundaries between the groups on Inverse Problems, Optimization and Control, and Imaging are fluent. Also, within the Analysis of PDEs-group, a strong program (in the framework of Dr. Fornasier’s START-project) in Imaging has developed.

The potential cooperations with existing working groups will also be a criterion for establishing junior groups.

All groups and the Institute as a whole have a strong visitors’ program and a great variety of international cooperations. These efforts have recently been restricted by the financial situation, but as soon as that improves, will be strengthened further.

4. RICAM cooperates with other disciplines in the framework of Special Semesters on topics of major current interest

Special Semesters, where the aim is to focus on a specific application area where the mathematical methods represented in RICAM play a role or on a specific mathematical area with emphasis on various applications during a whole semester, have been quite successful until 2008. Each of them attracted more than 100 visitors from all over the world, both as long-term visitors and within various workshops. Due to the financial situation, a Special Semester on Inverse Problems had to be cancelled. As soon as the financial situation is stable enough, RICAM will re-introduce Special Semesters. For doing so, medium-term financial security is necessary, since the planning of such semesters has to

be done at least two years in advance. For this and also other reasons, RICAM needs a three-year budget period based on performance agreements.

5. RICAM wishes to attract gifted PostDocs from all over the world and to provide an environment preparing them for international careers in academia or industry

The Institute has a strictly international orientation as far as personnel recruitment is concerned, and most contracts are and will be strictly limited in time. A measure of success will be, that those scientists who spend PostDoc years at RICAM have a good chance to get tenured positions all over the world. So far, we have been quite successful in this. The establishment of the Transfer Group will also strengthen the position of our graduates for industrial employment.

6. RICAM cooperates with universities by involving PhD-students into its research projects

Since the Academy of Sciences cannot grant a PhD degree itself, it is necessary (and also desirable) to cooperate with universities. So far, degrees of our PhD-students have been mainly granted by the Johannes Kepler University Linz and the University of Vienna. It is also of importance, that our PostDocs have the chance to obtain a habilitation, which will (as up to now) be mainly done at those two universities. In the course of reaching habilitation, our PostDocs will also have the chance to do teaching at these and maybe other universities and thus positively influence also the scientific development at our partner universities.

7. RICAM promotes, through its work and reports about it, the role of mathematics in science, industry and society

As mentioned above, RICAM will, in the next years, play a more active role in technology transfer together with IMCC. In addition, RICAM and IMCC have in the past and will also in the future contribute to changing the public perception of the role of mathematics by various reports in mass media.

Structure: Until the current financial crisis, we were happy with the current legal structure of an Academy Institute. All the goals up to 2020 can be reached in such a structure, but budgets should be known in advance over a longer period. We are also open to a different legal structure as long as major decision can be taken by the Scientific Director, based on the allocated budget.

While currently most groups are led by university professors, in 2020 the situation will be different: The current group leaders might retreat to positions as Scientific Advisors and group leaders of a younger generation should be hired after international advertisement, in most cases on tenured positions and/or, if possible, by joint appointment with one of the universities closely related to RICAM.

In 2020, RICAM will have been some years in the new building in the Science Park at the Johannes Kepler Universität Linz, while the group "Mathematical Methods in Molecular and Systems Biology" will reside in the Vienna BioCenter close to many of its cooperation partners. Most groups and thus the core of the Institute will probably still be in Linz in 2020, groups established close to their cooperation partners like the

current one in Vienna will still be the exception. Due to the connection with IMCC and to industrial partners, also the Transfer Group will be located in Linz.

Of course, this Vision 2020 is a plan, and plans will have to be adapted both to new developments and chances and to financial circumstances. We are convinced that if the Institute develops into this direction, future evaluation reports will be as positive as the last one and RICAM can keep and strengthen its position as one of the internationally leading Institutes in Computational and Applied Mathematics.

Prof. Heinz W. Engl, Institute Director
September 24, 2009