BRNO UNIVERSITY OF TECHNOLOGY

EVALUATION OF RESEARCH, OTHER CREATIVE ACTIVITIES AND DOCTORAL STUDIES AT BUT 2024

Evaluation report for an Evaluated Unit

Research and Artistic Activities

Brno University of Technology
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Czech Republic

I. Evaluated unit

Evaluated Unit Identification

Name	Institute of Mathematics
Faculty	Faculty of Mechanical Engineering

Evaluation Panel Members

	First and last name of the evaluator	Institution of the evaluator
1.	Roberto Fontana	Politecnico di Torino
2.	Thomas Michely	Universität zu Köln
3.	Sara Bagherifard	Politecnico di Milano

II. Assessment of Research and Artistic Activities
a. Scientific/Artistic Performance and Excellence

Assessment:

Provide an assessment of the Evaluated Unit's (EvU) performance and achievements addressing the following criteria:

- Relevance and timeliness of research/artistic topics
- Research/artistic outputs (publications, applications)
- Ongoing collaboration (within the university, within the Czech Republic, and internationally, including collaboration beyond the academic sphere and the establishment of a collaboration strategy)
- Research/Artistic infrastructure
- Future Research/Artistic Direction of the EvU
- Support of human resources inside the EvU

Include both strengths and areas for improvement.

> **PRELIMINARY REMARK**
> **Regarding the evaluation report for the Institute of Mathematics (IM), my primary observations are based on my recent visit to IM on November 5, 2024, at BUT. I also consulted the 2019–2023 Self-Evaluation Report as a supplementary source of information. I focused on the visit itself for more current insights. During the visit, I had the opportunity to meet privately with some PhD students.**
>
> **IM is involved in teaching in 7+ study programs, five of them under IM. The programs cover all degrees. In terms of the proportion of teaching hours IM is at the first position among the thirteen institutes of the Faculty of Mechanics (FME). In terms of FTE the size of IM is approximately around the second place among the Insitutes of FME. In 2023 there were 38.7 FTE**

including 31.6 FTE for professors, more specifically 6.7 full professors, 12 associate professors and 12.9 assistant professors. The total annual budget of IM is approximately 2.5 Meuro (2023). IM focuses on applied mathematics including applications of mathematics but also basic research. The main scientific outputs are papers.

RELEVANCE AND TIMELINESS OF RESEARCH
The research topics of IM look timely and relevant. The current list of topics includes (i) Image analysis, (ii) Applied Theory of Dynamic Equations of Real Orders, (iii) Applications of game theory, optimization, and graph theory to waste management, logistics, and transportation, (iv) Geometric methods in engineering.

RESEARCH OUTPUTS
According to the IF (Impact Factor) presented by the Head of the Institute of Mathematics, IM is at the third position among the thirteen units of FME. It looks as a good result even if how the IF is computed should be better clarified.

ONGOING COLLABORATION
According to what has been presented on Nov, 5, collaborations at the national level are present with almost all institutes of FME. In CZ, IM has close contacts with all major universities (Charles University, CTU Prague, MUNI).
The list of foreign Universities involved in ongoing collaborations at international level includes
(i) University of Cambridge, UK, (geometric algebras, 2 internal UC grants for visiting BUT professors, mutual reviews of PhD theses, common project COST, organization of common conferences)
(ii) University of Hawaii, USA, (common research on Solar corona for 20 years, common publications, common grants supported and/or financed by NASA and NSF, commercial software development)
(iii) University of Palermo, IT, (artificial intelligence in medical imaging, student internship exchange, common MSCA grant proposal, organization of common conferences and seminars)
(iv) Other: UPC Barcelona (E), University of Campinas (BR), Osaka Prefecture University (Japan), University of Florence (IT), Institut fuer Technische Physik Berlin (D), University of Almeria (E), Technische Universit¨at Darmstadt (D).
In my opinion the collaboration looks very good at the national level and good at the international level. I have to mention that both the Institute of Physical Engineering and the Institute of Material Sciences defined the collaboration with IM present but in a sporadic way. I had the impression that the level of cooperation between IM and IPE is low and should be increased.

RESEARCH INFRASTRUCTURE
IM has standard office equipment and computer technology. In case of necessity, it uses the laboratories of FME and CEITEC. In the case of more complex calculations, it uses a metacenter-type cluster. It currently hosts two laboratories used to support applied research.
It appears that it is not a critical issue for IM.

FUTURE RESEARCH
IM would like to be nationally and internationally recognized as a mathematical workplace through the collaboration with international and internal scientific teams.
IM will focus on supporting excellent research in applied mathematics, such as creating models and software tools for applying mathematical principles. The focus of the research will be coherent with the European Union's technology priorities. IM will allocate part of the scientific capacity of the Institute to:
(i) the development of the field of artificial inteligence (AI). Especially the application of AI in image analysis and the statistical aspects of AI.

> **(ii) the study of statistical partial differential equations and statistical modelling.**
> **(ii) the study of quantum computing (QC). In this area, several impact papers in the first quartile have been published on IM in the last three years. A new research group will focus on the mathematical aspects of QC to develop a new mathematics tool to optimize quantum circuits and relativistic QC models.**
> **The poposed themes of research looks interesting and relevant.**
> **SUPPORT OF HR**
> **One of the keys of HR policy of IM is to support scientific groups dealing with priority topics.**

Recommendations:

Suggest specific actions the EvU could take to enhance its scientific/artistic performance.

> **I had the impression that the working internal atmosphere at IM is excellent. They look as a family and this nice atmosphere is appreciated also by the Phd students. My recommendation is to mantain this way of working because it is fundamental for the future success of the Institute.**
>
> **IM expressed the appreciation and need of international cooperation. But, referring to table 2.2 of the Self-Evaluation Report the total funding from international grants is zero for the period between 2019 and 2023. It is worth noting that IM declared that some very recent COST (European Cooperation in Science and Technology)-actions are close to be funded. These are**
> **(i) Relativistic Quantum Information (RQI), COST Action CA23115**
> **(ii) Continuous and Discrete Fractional Differential Equations: Analysis and Applications, COST Action OC-2024-1-27094**
> **(iii) Cartan geometry, Lie,Integrable Systems, quantum group: Theories for Applications, COST Action OC-2021-1-25132 CaLISTA.**
> **IM pointed out that the paperwork/burocracy for proposal preparation and project reporting is very high and this prevents IM to put efforts to significantly increase this part of the budget. My recommendation is to find the necessary support for proposal preparation by the administration office of BRNO. In my opinion the role of this office is crucial in this regard. Another important ingredient for successful proposal preparation is the quality of the Consortium. The active participation at international conferences is relevant for networking.**
>
> **The possibility to increase the international cooperation through international grants would have also a positive impact on publications. Even if the IF factor places IM among the first three institutes of FME in terms of publications and there are 4 publications, dated 2023, in the first-decile journals, other indicators are still quite low (for example the CNCI is always less than 1, see chart 2.5 of the Self-Evaluation Report).**
> **My final recommendation on the publication issue is quite specific and refers to the graph at page 4/14 of the slides used for the presentation. IF should be explained and the corresponding values should be placed on the y-axis to facilitate the comparison among different Institutes. The same remark applies also to page 3 and 5 of the same presentation, even if in this case the lack of these information is less relevant.**

b. Societal and Economic Impact

Assessment:

Please assess the impact of EvU's research and artistic activities on society and the economy, as well as their potential for future impact (relevant for evaluated units focusing on applied research). Your evaluation should address the following criteria:

- Demonstrated societal and economic impact of research/artistic outputs through examples (value, contribution, or change for society, economy, culture, public policy, legislation, public services, health, social issues, environment, quality of life outside the academic sphere, etc.)
- Service to the scientific community and recognition by the scientific/art community (participation in committees, editorial boards, invited lectures, etc.)
- Recognition by society and media coverage

> **Concerning the societal and economic impact IM pointed out the following initiatives**
> **(i) transfer of knowledge to Czech companies in the form of students' employment (SKODA Digital, Aricoma, Honeywell, Thermo Fisher, Nuvia)**
> **(ii) software for optimization of truck tracing (license sold)**
> **(iii) optimization of waste processing (algorithms for commercial software)**
> **(iv) optimization and control of local energetic communities (SW development)**
>
> **In my opinion algorithms and software development represent a good way to transfer results.**
> **IM listed also the following memberships**
> **(i) Scientific board memberships (OSU, MUNI, Charles University, UPOL)**
> **(ii) Science Foundations memberships (GACR, COST)**
> **(iii) Professional organization memberships (Statistical Society (board member), Mathematical Society, Council for Robotics and AI at Czech MoD)**
> **(iv) Regular members of PhD committees, regular reviewers of PhD theses, memberships in University Boards for PhD programs**
> **(v) Regular invited speakers (2-3 each year), memberships in conference Program Committees**
> **These memberships are relevant but in my opinion they are mainly limited at the national level.**

Recommendations:

Suggest ways the EvU can further enhance its societal and economic impact or broaden the reach of its research/artistic contributions.

> **Software development represents a good way to transfer the output of research. In my opinion consultancy to companies is another option that should be taken into account and it is often connected to software development.**
> **The results of some activities could be presented to the large public through dedicated events. Social media could also be used. Among the expected benefits there is the possibility to attract new students to mathematical studies and to make citizens aware of the importance of the mathematics in real-life.**
> **As I wrote before, in my opinion the international dimension should be expanded. This action would have a positive impact also in this context for example facilitating the participation in editorial boards of international journals and conferences.**

c. Research Funding

Assessment:

Evaluate the EvU's success in securing research funding from various sources. Consider the effectiveness of their strategies in obtaining grants and generating income from contract research and commercialization.

Please address the following criteria:

- Success in Applying for International and National Grants (and any measures taken to increase success rates)
- Income from Contract Research and Commercialization

> **I have considered the year 2019 in comparison with 2023. I have analysed the corresponding values as available in Table 2.2 of the Self-Evaluation report.**
> **There has been a significant increase in the total budget. From 1,559 M€ in 2019 to 2,450 M€ in 2023, i.e. almost +60%.**
> **Looking at the distributions of the total budget into the different sources I observe that:**
> **(i) education, core research funding, national grants and other are stable (they accounts for 73%, 21%, 3%, and 0.5% of the total budget respectively both for 2019 and 2023)**
> **(ii) technolgy transfer and commercial income increased from 0.3% in 2019 to 2.8% in 2023 (from 5134€ in 2019 to 68402€ in 2023).**
> **In my opinion there has been a very good increase in technology transfer and commercial income. The weak point is the zero funding coming from international grants even if it should be pointed out that COST actions CA23115, OC-2024-1-27094 and OC-2021-1-25132 CaLISTA are not considered in the Self-Evauation plan but look close to be finalised.**

Recommendations:

Provide recommendations to improve the EvU's success in research funding, such as enhancing grant application strategies, exploring new funding sources, or increasing income from commercialization.

> **Technology transfer and commercial income increased significantly from 2019 to 2023. Nevertheless, in 2023, technology transfer and commercial income together account for only 2.8% of the total budget. In my opinion, this budget source could be expanded by leveraging IM's expertise in software development, potentially in collaboration with other FME institutes, such as the Institute of Physical Engineering. Additionally, beyond software development, another potential source of income could be consultancy services for companies operating in the Czech Republic.**
> **As for international funding, I have already provided my recommendations in previous sections.**

d. Final Summary of Evaluation and Recommendations

Provide a concise summary of the EvU's performance across all sections, highlighting key strengths and any critical areas needing improvement. Include final recommendations for the EvU's development and future focus areas.

> **In my opinion:**
> **(i) The main strength is the family-like working atmosphere combined with a genuine interest in mathematics. This aspect was confirmed by both professors and PhD students.**
> **(ii) The main weakness is the lack of international funding. The number of projects in this area must be significantly increased, overcoming the time barrier required for project proposal preparation. Support from central administration offices appears crucial in this regard.**
>
> **Finally, I chose A2 because my overall impression of IM was very positive, and I believe that the existing challenges can be overcome in the very near future.**

e. Evaluated Unit's Grade

Grade	Awarded grade[1]
A1 – outstanding (high international level)	Click or tap here to enter text.
A2 – very good (above-standard international level)	X
A3 – good (standard international level)	Click or tap here to enter text.
B – satisfactory (moderate level of research performance)	Click or tap here to enter text.
C – insufficient (limited research performance)	Click or tap here to enter text.

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[1] Enter "X" in the cell of the row that corresponds to the selected grade. Leave other cells in the column blank.