

# **Evaluation of the Research and Professional Activity of the Institutes of the Czech Academy of Sciences (CAS) for the period 2010–2014**

## **Final Report on the Evaluation of the Institute**

**Name of the Institute:** Institute of Physiology of the CAS, v. v. i.

**Fields, in which the Institute registered its teams:**

Computer and information sciences

Observer representing the Academy Council of the CAS: Jan Šafanda

Observer representing the Institute: Ladislav Vyklický, substitute observer Jiří Pácha

### **Commission No. 2: Computer and information sciences**

Chair: Professor Edwin Hancock PhD, DSc.

Date(s) of the visit of the Institute: November 23 - November 25, 2015

Programme of the visit of the Institute: see attached Minutes from the visit

Evaluated research teams:

*No. 18 - Computational Neuroscience*

## **A. Evaluation of the Institute as a whole**

### **B.**

#### **1. Introduction**

The Institute of Physiology is a unique Institute of CAS engaged in biomedical research. The main mission is elucidation of fundamental biological mechanisms to improve prevention, diagnostics, and therapy of numerous human diseases. A research in the domain of informatics forms only a tiny portion of the whole activities so the competence of the Commission-2 was rather limited.

#### **2. Strengths and Opportunities**

The Institute can demonstrate excellence in several scientific domains and thus can perform effective research on multidisciplinary topics. It effectively cooperates with Universities and other medical research centers in Czech Republic and abroad. The Institute contributes to high-quality education both on the undergraduate and graduate levels.

#### **3. Weaknesses and Threats**

The age structure of the Institute can improve, provided sufficient support for post-doc researchers is found. The threat seems to be a low acceptance rate of many grant agencies supporting research in Europe.

#### **4. Recommendations**

In addition to the team of Computational Neuroscience, the Institute should consider investing in additional informatics-related computational disciplines, such as medical informatics or computational biology. In this way a critical mass could be reached in bio-informatics and computational biology. These are emerging and important areas at the frontier and at the intersection of biology, medicine, and computer science.

#### **5. Detailed evaluations**

**Declaration on the quality of the results and share in their acquisition.** The institute has published more than 700 papers and received 12 patents. Among them, 3 papers were from Nature and 31 with impact factor greater than 7. Though the average impact factor decreased a bit recently, it is still very high.

**Declaration on the involvement of students in research.** A good number of students at all levels are involved in research. The average number of students supervised per senior scientist is 1.0 BSc students, 1.4 MSc students, and 1.3 PhD students. The number of PhD theses defended in 2010-2014 is 64. PhD students are involved in about 70% of the publications. The Institute coordinates a PhD program jointly with Charles University and can present itself as a Graduate School in Biomedicine. The PhD study program is well structured and includes a rich training program and various review and feedback activities. More than 50% of the graduating PhD students stay in the Institute as post-docs.

**Declaration on societal relevance.** The Institute is mainly concerned with fundamental research, which often has direct or indirect clinical impact. Examples of impact include improved diagnosis of inherited mitochondrial diseases, improved therapeutic strategies for type 2 diabetes, and improved presurgical examination and epilepsy surgery. The Institute is very involved in educational activities, with more than 5,000 hours of lectures given at 14 different faculties. Furthermore, the Institute collaborates with the business sector and reports 15% of its total funding to be from this source in 2014. Contractual research included a substantial contract commissioned by Sevapharma, a.s. concerning preclinical testing. The Institute maintains an extensive library collection covering biomedicine and related areas. The Institute's involvement in outreach and research popularization is substantial, with numerous public lectures, articles in popular-science magazines and participation in TV and radio broadcasts.

**Declaration on the position in the international and national context.** It is very difficult for the commission of Computer Science to evaluate the position of the Institute of Physiology in comparison with international leading teams. The evaluated research team, claiming to produce results in informatics, forms only about 4% of the research staff of the institute. Though most of the grant funding comes from Czech resources (GACR, MSM) there are also projects from European FP-6, FP-7 programs, as well as other frameworks, such as COST. This is very important for international collaborations and contacts in general. BIOCEV is a new EU-funded center, which includes six research teams of the Institute and Charles University. The institute also has close ties with advanced institutes both in Europe and the USA, however the extent and specific form of the cooperation have not been reported. The Physiological Research Journal, published by the Institute, maintains a relatively high and sustainable impact factor. Though the number of different research groups (departments) is high, the institute tries to encourage close cooperation between them, but the relationship graph of the cooperation looks rather complicated which might cause some difficulty in the management procedures.

**Declaration on the vitality and sustainability.** The sustainability of the 23 scientific and 6 service departments is based on close cooperation and common strategies to raise funding for a high quality research. The age structure of the largest Institute of this type in Czech Republic suggests a strong involvement of young researchers, however the question might be how many of them will finally reach the level of top ranked scientists. Financial support of young researchers is important from the long-term perspective. By cooperation with universities, high number of PhD students is involved in research activities of the Institute. Also the number of postdoctoral fellows is reasonable. Putting the emphasis in research evaluation on the classical academic values, such as publication and citation record, is appreciated, though the activities in research grants or organizing international congresses, are also very important. Evaluation of teams has become a standard, but automatic categorization of teams for dividing budgets is dangerous, leading to concentrating activities on fulfilling the objective criteria rather than achieving actual scientific results.

**Declaration on the strategy and plans for the future.** The strategic plan for the future looks to be well elaborated. With the basic research in the area as the primary objective, it also comes with new initiative for collaboration among teams. By organizing seminars and conferences, the quality of PhD student's training will increase. Though involvement of PhD students is important, the work of postdoctoral researchers is even more important, because they already know the principles of scientific work and are usually enthusiastic about their work – Start-up program for junior scientists is a good idea to implement. International cooperation of any form is a key strategy. One, usually inexpensive,

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implementation is to send junior Czech researchers abroad. Coming back, preferably after several years, they typically represent a major improvement factor for the research teams.

## **C. Evaluation of the individual teams**

### **Evaluation of the Team No. 18: Computational Neuroscience**

#### **1. Introduction**

The team is oriented at a specific part of the field of computational neuroscience, i.e. analysing the neuronal information activities at the level of individual neurons or small neuronal clusters (stochastic neuronal models, neuronal information processing, neural development and motion control), including the respective parts of theoretical statistics. The work is mainly theoretical and partly also on experimental data provided by collaborating institutions both in the Czech Republic and abroad.

#### **2. Strengths and Opportunities**

The current team strength is based on the good scientific reputation of its senior researchers and an extensive set of well chosen international collaborations. The current young team members (PhD students) may potentially provide a new stabilization factor for the team in the future.

#### **3. Weaknesses and Threats**

The team seems to work in a relative isolation at CAS with little interface to the broader developments in informatics and the rapidly progressing method development in the computational sciences. The team's plans are possibly endangered by unstable financing due to ending grants or otherwise irregular financial support, dependent on changing ranking systems.

#### **4. Recommendations**

It might be recommended to consider expanding the department, which would allow inclusion of further areas of the broad field of computational neuroscience. This might be partly covered also by increasing the cooperation inside the Institute and with other national institutions. Alternatively, modifying the name of the department to a more specific one might be considered.

#### **5. Detailed evaluations**

**Declaration on the quality of the results and share in their acquisition.** Research activities were concerned with the analysis of stochastic neuronal models, information processing in sensory neurons and neuronal models, neural control of rhythmic motion, and biophysical modeling of neural development. Key results include new measures of statistical dispersion and variability of random variables, new methods for analysis of data with low signal-to-noise ratio, new neural information processing procedures, and others. The total number of outputs is 37 with 32 of them included in the WS. Given an average annual personal capacity of 3.9 FTE for researchers, the productivity of the department can be considered satisfactory. The quality of the publications, as assessed in Phase I, is good with a Quality Profile median value of 3 (recognized internationally) and an average of 2.75.

Based on the AIS journal ranking, the quality of the publication venues is very good with 1 paper appearing in a journal ranked in the top decile and 22 papers in a journal ranked in the upper half. The contribution of the team to these publications is very significant. The work of the department received a very good degree of international recognition as evidenced by the number of citations.

**Declaration on the involvement of students in research.** There are good numbers of students associated with the group at bachelors, masters and PhD levels. At PhD level there are about 6 active students, which although not saturating the available supervision resources strikes a good compromise in terms of attention per student. PhD students have been responsible for initiating 13 high quality papers. They have also made important training visits to overseas research labs. and conferences. Overall the training environment for PhD students appears very good, and the students appeared highly satisfied with their experience.

**Declaration on societal relevance.** The group is involved in teaching in Czech universities, presenting courses at Charles U., Masaryk U., and also externally at Copenhagen U. There is a good amount of popularisation activity, with a number of interviews on Czech TV and radio. Although the group has acquired results which might have significant medical impact in the future (e.g. metabolic workload of information processing, and which could lead to new neuronal measurement and assessment techniques), nothing concrete is listed for the period.

**Declaration on the position in the international and national context.** The department belongs among important internationally recognized teams in the field, with strong international cooperation activities that are extensive and important in the specific research area. Although the research does not cover all aspects of applications of information and signal theory and higher statistics in neuroscience, its breadth – considering the size of the team - is substantial and encompasses some important directions in depth. Based on the international credits of the team senior researchers and the interesting project directions, the team is capable of attracting foreign researchers, as proved by the previous or existing stays of PhD students, as well as by frequent collaboration of foreign researchers and their participation in common publications.

With respect to the small size of the team, the width of research directions is substantial and it might be difficult to include still another direction with the depth comparable to the ones established in the group. The existing research can thus be considered not to have missing directions. However, it might be of interest for the future to consider inclusion – when there is a possibility for expanding the department of computational neuroscience – also the multivariate analyses of multidimensional medical data obtained by MRI / fMRI / DTI MR brain imaging possibly complemented by simultaneous multichannel EEG registration that are now considered a substantial part of neuroscience.

The basic funding, besides the institutional one, came from grants of the centres of excellence whose outputs are obviously under strict national evaluation. Besides that, some means are or have been provided also by concrete foreign grants. No contractual research for industrial or medical spheres has been running. The management of the small team is straightforward and may be considered adequate.

**Declaration on the vitality and sustainability.** Considering the reasonable age structure of the team and its good scientific position, the vitality and sustainability seems guaranteed, providing that some of the PhD/postdoc team members would be stabilised by regular employment.

**Declaration on the strategy and plans for the future.** The outlined strategy of the theory based research in the three mentioned directions goals (Neuronal information processing, Biophysical modelling, Advanced statistical methods of neuronal data analysis) appears adequate, and the means and human resources are sufficient for the claimed plans. However, should the department still carry the generic name of computational neuroscience, widening its scope, e.g. by the multivariate analysis of multidimensional medical data obtained by MRI / fMRI / DTI MR brain imaging, also complemented by simultaneous multichannel EEG registration, may be considered, possibly in collaboration with the well equipped neuroscience medical centres existing in the Czech Republic.

**Date:** December 21, 2015

**Commission Chair:** Professor Edwin Hancock PhD, DSc.