

**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 Information Theory and Automation of the CAS, v. v. i.**

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

Electrical engineering, electronic engineering, information engineering

Observer representing the Academy Council of the CAS: Jiří Chýla

Observer representing the Institute: Antonín Otáhal, substitute observer Milan Zajicek

**Commission No. 8: Engineering and technology**

Chair: em Prof.DI.Dr.Dr.hc. Hans Peter Nachtnebel

Date(s) of the visit of the Institute: October 12 - October 21, 2015

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

Evaluated research teams:

*No. 2 - Department of Control Theory; No. 7 - Department of Signal Processing*

## **EVALUATION OF THE INSTITUTE OF INFORMATION THEORY AND AUTOMATION (UTIA)**

### **1. INTRODUCTION**

The institute has eight departments from which two were visited: namely the dept. of signal processing and dept. of control theory. The other departments (adaptive systems, econometrics, pattern recognition, stochastic informatics, image processing and decision making theory) were out of scope of this evaluation committee.

The institute is run by a director and two deputies: one for research and for operation. The latter is responsible for the management of the support departments including the IT centre, the business administration and the library. The research deputy director is managing all the eight research departments.

#### **1.1 Location of the institute and its dept., labs. & sub units.**

The institute has moved several times and since 2008 it is located in Prague 8 in a new building.

#### **1.2 Brief history of the institute**

The institute was established in 1959 and became a public research institution in 2007.

#### **1.3 Mission and research topics**

The main mission of the institute is seen in fundamental and applied research in

- computer science,
- artificial intelligence,
- signal and image processing,
- pattern recognition,
- applied statistics and related fields,
- system science,
- control theory.

Obviously, the institute covers a broad range of topics.

#### **1.4 Staff size and full time equivalents age distribution**

In total 184 people work at the UTIA corresponding to 145 full time equivalents from which 140 are researchers (equivalent to 105 FTE). During the evaluation period about 34 foreign researchers worked on a short term contract basis at UTIA. With respect to the age distribution most of the researchers are between 30 and 45 years.

From the 145 FTE about 30 FTEs are in the administrative sector and 8,6 in technical support.

## **2. STRENGTHS AND OPPORTUNITIES**

### **2.1 Timeliness of research topics**

The institute exhibits a broad range of expertise which can be seen as a strength as long as there is a good cooperation and balance in scientific outputs among the depts. The research topics are innovative.

In 2010 the institute has revised its structure and has agreed on the recent research topics. New research topics will be proposed by the dept. and team leaders, dependent on international calls. This approach seems to be flexible enough to promote new topics and to involve PhD students.

### **2.2 Budget: Ratio of institutional budget, grants and contractual resources, international funds**

The annual budget of the UTIA is 4,8 Mio € from which about 50 % originate from institutional funding by CAS, while 35 % come from national research projects. Financial resources from EU contribute about 8% to the annual budget that is considered as a rather small contribution.

The Annual budget for 2014 included about 2.4 M € from institutional funding by CAS, 1.7 M € from national research projects, 0.4 M € from EU projects, and 0,2 M € from commercial projects and about 0.1 M € from other sources. This implies that about 50 % of the total annual income of 4, 8 M € originated from external funding.

These figures are also reflected by the project structure. From about 44 projects executed during the evaluation period about 34 were funded by national agencies (GACR, TACR) while seven projects referred to EU programs.

### **2.3 Intensity of collaboration among teams and among institutes, national collaboration and international involvement**

In teaching there is an intensive collaboration of the institute with most of the Czech universities. Also, a few contribution to international summer courses are documented. The UTIA scientists are strongly engaged in international scientific community activities as can be seen from the number of submitted papers (430) to international conferences.

The DAR centre provides also a sound platform for intensifying the collaboration with outside partners, either from other universities and/or with enterprises.

### **2.4 Position of the institute within the Czech scientific community and its international position**

The institute is well imbedded in the national scientific community, mostly via teaching at several universities but also by joint research activities with universities and companies. Due to the long term publishing of Kybernetika Journal it has also a good international visibility.

### **2.5 The overall capacity of staff**

Besides its research and publication activities, UTIA is involved in undergraduate, graduate, and postgraduate education through study programs jointly executed mainly with four universities. It publishes the journal *Kybernetika* and acts as a certified forensic expert institution in computer science and IT with special expertise in image and video authentication.

## **2.6 Reasonability of the structure of the departments**

With about 200 employees and 8 research departments the institute has a reasonable structure with a flat organisational structure. Some depts. are subdivided into research groups related to ongoing projects.

The percentage of the administrative and technical staff is altogether about 25 % of full staff capacity. This is considered as a good ratio and should be kept.

## **2.7 Age structure and qualification**

The age distribution of staff is well balanced. Many younger researchers are guided by a good ration of senior researchers. Most of the researchers are between 30 and 45 years. The institute is able to attract numerous young researchers at master and PhD level.

## **2.8 Frequency and quality of publications**

The scientific output is rich. During the evaluation period 324 IF (impact factor) papers were published. Additionally, 16 books, 36 book chapters and more than 100 papers (in non IF journals) were published. Further, 430 contributions to international conferences are reported.

Since 1965 UTIA issues also the journal *Kybernetika* with six issues per year. The impact factor of the journal was in 2014 0.54. In 2012 the impact factor was slightly higher with about 0.62. but it increases slightly in the long term. About 70 papers are annually published.

## **2.9 Patents and role in contractual work**

There are some interesting contractual projects with companies (see also under 5.3) but the financial revenues from these projects are rather small compared to the whole budget.

# **3. WEAKNESSES AND THREATS**

## **3.1 Timeliness of research topics**

It is difficult to assess the timeliness of the research topics of UTIA. Considering that about 50 % of the budget is covered by external grants the topics have to be positively evaluated. With respect to the number of publications in high quality journals the research topics deserve a critical review.

## **3.2 Budget: Ratio of institutional budget, grants and contractual resources, international funds**

There is a good balance between institutional financing and project income.

The grants from EU projects are in total small and could be increased. From the listed projects it can be concluded that there are several EU projects (2014-2017) with quite a small budget (3-8 k€ for 2014) allocated to UTIA. Perhaps the grant income in the coming years will be higher but this cannot be concluded from the documents. It should be assessed if such a minor involvement is beneficial for the institute.

### **3.3 Intensity of collaboration among teams and among institutes, national collaboration and international involvement**

The internal cooperation among depts is not very clear. It was mentioned during the onsite visit that only a few collaborative links exist between the depts. and that collaboration among them should be improved. Surprisingly, numerous joint papers with authors from different depts. are published.

It was also mentioned that several joint project applications have been submitted to increase the probability of successful applications. This does not necessarily imply that there is really an intensive collaboration among the depts..

### **3.4 The overall capacity of staff**

The involvement of students in the various research activities of UTIA is seen as a strong point. However, about 25 % of the PhD students do not complete their studies. This is considered as a weakness because highly qualified expertise is being lost for the institute and the society. The reported drop out rate is substantially lower compared to Charles university.

### **3.5 Frequency and quality of publications**

Considering 105 FTE in research and 331 IF journals a researcher published below 1 IF publication per year. In the average the publication frequency, especially in IF journals, could be increased.

Considering the journal *Kybernetika*, issued by the institute, there serve 33 scientists as editorial board members (plus chief and deputy editor) from which 8 are from outside the Czech Republic. It is recommended to invite more international scientists to serve as board members of *Kybernetika*. This would also raise the visibility and attractivity of the journal, in general.

## **4. RECOMMENDATIONS**

### **4.1 Re-organisation of the internal structure of the institute and departments,**

The institute has undergone a re-organisation of its structure in 2010. So, the recent structure should be kept for the next years to provide ample time to learn about the performance of the various depts.

It is considered as a fruitful activity to establish external research centres, like DAR, together with other universities and companies. In the management structure of the institute DAR is directly supervised by the director but it is not clear how DAR is collaborating with the existing 8 depts. at the institute.

Also DSP exhibits like DAR a strong affinity to applied research. Thus, it is difficult to evaluate the performance of DSP because other criteria would be more appropriate.

In general, the collaboration among the depts. should be improved.

#### **4.2 Internal programs to stimulate actions to enforce strengths and to reduce weaknesses**

UTIA has implemented several measures to attract people from university and from abroad. The best approach seems to be within international research programs. So far, EU projects contribute less than 10% to the annual budget. Obviously, this percentage should be substantially increased without taking the risk of dissipating research capacities in projects with minor budgets.

UTIA has also developed some incentives to stimulate fund raising activities and the frequency of publications in reviewed journals.

### **5. DETAILED EVALUATION**

Commission 8 has visited 2 depts. from eight in total. Thus, the statements below are restricted to the small sample of two depts.

#### **5.1 Declaration on the quality of the results and share in their acquisition**

##### ***Characterisation of the main research activities (experiments, theoretical areas)***

UTIA's activities refer to fundamental and applied research. The topics, reflected by the 8 depts plus the DAR centre, exhibited a broad range. This is a strength in applying for research projects but it includes also some risk with respect of diversification.

##### ***Overall quality of publications and contributions of the team to publications***

The number of publications is high. During the evaluation period more than 900 scientific publications are listed altogether. During the evaluation period 324 IF (impact factor) papers were published.

In Phase I of the evaluation procedure 153 papers have been evaluated. 13 of them (about 8 %) were considered as world leading scientific contributions. About 50 % were internationally excellent, or better. 27 (7%) ranked in the top decile of AIS journals and 48 (13 %) in the highest quartile.

The individual output is below 1 IF paper per year.

##### ***Specification of the main achievements***

The establishment of the external DAR centre and the role of UTIA in the AV21 strategy, especially the coordination of the only program in mathematics and computer science are considered as major achievements.

## **5.2 Declaration on the involvement of students in research**

UTIA scientist are strongly involved in teaching at universities (contribution to about 60 courses) and together with available financial resources from external projects numerous young researchers can be attracted. Currently 57 PhD students are supervised by staff members. About 50% of PhDs are part time employed at the institute.

Additionally UTIA provides several social benefits for the staff, such as a free restaurant voucher, support of recreational activities, etc. Some financial incentives have been implemented to attract PhD students and to encourage publication activities. All together, these social incentives sum up to about 200 k €/a.

It is worthwhile to mention that the institute had a leading role in accrediting, jointly with Charles University, a new PhD study branch entitled “Computer Graphics and Image Analysis”. UTIA also contributed to several other MSc and/or PhD newly introduced courses at the collaborating universities. It can be summarised that the institute plays an active and innovative role in higher education.

## **5.3 Declaration on societal relevance**

### ***Impacts of the results and other activities on economy***

Some of the listed projects are of direct impact on economy, such as the SKODA and TESTO project. The total revenues from practical research and technology transfer are rather small. It contributes for the whole period 2010-2014 about 720 k€, from which the SKODA project is by far the largest with 581 k€. The total revenues contribute about 3,7 % to the annual budget.

The PIZARRO project is considered to be relevant for the society as it is already in use at 50 police stations throughout the country.

### ***Outputs providing information relevant for public policy decisions in all fields of life***

The involvement in the AV21 strategy is an activity which is of practical importance not only for the CAS institutions but also for the society. UTIA plays an important role in this process. Further, its forensic expertise in cybernetics supports court decision and provides basic information for police.

### ***Popularisation and similar activities***

Within the “Science and Technology Week” organised annually by CAS the institute presents its work in form of an “Open house”. Within this framework several lectures are delivered, although the number of participants is rather limited. Additionally, plenary lectures are delivered by staff members in the main building of CAS.

## **5.4 Declaration on the position in the international and national context**

The institute has excellent links in research and teaching with several universities, especially Charles university, Czech TU, University of Economics, Prague, University of West Bohemia, University of

Ostrava, Brno University of Technology, TU Ostrava, TU Liberec. The excellency of the scientific work is also recognized by the numerous awards obtained by the researchers.

Due to the long term publishing of Kybernetika Journal it has also a good international visibility. 34 foreign researchers worked within short term contracts at UTIA. This number could be increased via international research programs, mostly at the EU level.

### **5.5 Declaration on the vitality and sustainability**

The number of researchers (145 FTE) and the excellent age distribution are considered as assets for future development. Most of the researchers are in the age between 30 and 45 years. Also the involvement of numerous scientists in teaching at the universities is essential for attracting students for research. According to level of qualification 25 PhD students, 15 Postdocs, 19 research assistants, 36 res. Fellows and 27 senior researchers were working by the end of 2014 at UTIA. Currently, 57 PhD students are supervised by UTIA staff members.

In general, the gender ratio is not well balanced as several institutes which were visited. Of course, in engineering sciences the ratio of female researchers is in general low but it would need an explicit program to attract and to promote them.

### **5.6 Declaration on the strategy and plans for the future**

The institute intends to keep the balance between fundamental and applied research. With respect to future research topics the institute does not plan major changes.

UTIA plays already an important role in the AV21 strategy and wants to take a leading role in the future within this program. At the moment UTIA is the coordinator of the single AV21 program in Mathematics and Computer Sciences.

Other goals are defined in attracting more foreign senior researchers and to get an ERC grant in the next few years.

From its scientific capacity UTIA is able to reach these goals. AV21 is considered as a promising activity of the CAS and it is seen as worthwhile to be more deeply involved in the execution phase. Attracting more foreign researchers is also a relevant goal. Due to the difference in salaries in EU countries this goal seems to be achievable via joint EU projects in which invited researchers could be paid directly from the grant.

To be successful in an ERC grant application is difficult to plan but it is an attractive goal.

## **EVALUATION OF THE INSTITUTE OF INFORMATION THEORY AND AUTOMATION (UTIA)**

### ***Team No. 2: Department of Control Theory (DCT)***

## **1. INTRODUCTION**

### **1.1 Brief history of the institute**

In the period from 60'ies to 90'ies the dept. had its emphasis on linear systems analysis and modelling and in the late 90'ies it concentrated on non-linear and chaotic systems.

### **1.2 Mission and research topics**

Theoretical research currently prevails in the Department of Control Theory (DCT) focusing on the control system analysis, feedback control design and general dynamical systems theory.

Applied research in the department focuses on numerical methods for control-system simulation and design.

### **1.3 Staff size and full time equivalents age distribution**

The total number of staff is rather small. Today 2 PhD-students, 1 Post Doc, 1 Research Assistant, 3 Res. Associates and 1 Res. Fellow are working at the institute.

During 2014-2014 the staff size decreased continuously. In 2010 8,95 (FTE) researchers, 3,68 PhD students were involved in research activities while in 2014 6,30 researchers and 1,45 PhDs were active.

5 from eleven scientists are below 40 years and 3 above 60 years.

## **2. STRENGTHS AND OPPORTUNITIES**

### **2.1 Timeliness of research topics**

The identified research topics are well in line with international research and are promising, also with respect to application, e.g. multi-objective decision making, coping with uncertainty and imprecise information.

### **2.2 Budget: Ratio of institutional budget, grants and contractual resources, international funds**

The DCT team has achieved during 2010-2014 several research grants which total up to more than 11 million of CZK (approx. in total about 410 k€ EUR). Considering only the research staff of 8,95 FTEs in 2010 and 6.3 in 2014, this results in external funds of about 10- 15k€/FTE and year. Considering the involvement of PhDs the per capita rate would be lower.

The institute has about 110 FTEs in research and an annual budget of 4,8 Mio € (2014) from which about 50 % originate from institutional funding by CAS. This results in external funding of about 22 k€/FTE and year researcher at the institute level. Based on the figures the external funding per capita is lower at the dept. level compared to the respective figures at the institute level.

### **2.3 Intensity of collaboration among teams and among institutes, national collaboration and international involvement**

DCT has several links to international institutions throughout the world. According to the listed “scientific outputs of team” about 15 % of publications listed an author from one of the collaborating teams. This underlines the liveliness of co-operations.

### **2.4 Frequency and quality of publications**

16 papers were evaluated in Phase I from which 6 were ranked as internationally excellent. One of them was considered as world leading. Based on the figures of research staff at the institute and at the dept. level DCT performs well with respect to number and quality of publications.

## **3. WEAKNESSES AND THREATS**

### **3.1 Budget: Ratio of institutional budget, grants and contractual resources, international funds**

The external budget from grants and contracts is rather low. Comparing staff capacity and research grants at the level of the institute with DCT it can be concluded that the department is underperforming.

### **3.2 Intensity of collaboration among teams and among institutes, national collaboration and international involvement**

The collaboration within the institute is rather limited and should be improved. Surprisingly joint papers are published with members from other depts. At the international level the cooperation is intensive and is highly appreciated.

### **3.3 Reasonability of the structure of the department**

With 6,30 active researchers and 1,45 PhDs the team is quite small, perhaps too small, to cover all the listed topics and to reach future plans.

## **4. RECOMMENDATIONS**

#### **4.1 Re-organisation of the internal structure of the institute and departments, laboratories, teams and groups considering the critical mass of each unit, the overlap of units**

The evaluation team visited only two depts. from eight in total. Thus, no generally valid conclusions can be drawn. But it can be concluded that the research capacity is limited due to the small number of researchers, although excellent publications have been elaborated.

It is strongly recommended to increase external funding by projects, e.g. EU programs. This would also provide financial resources to employ PhD students.

So far, international researchers are involved via joint co-operation. That's good but it is also recommended to formalise and intensify the co-operation by joint research programs. This would also provide options for at least short term contracting of external researchers.

#### **4.2 Internal programs to stimulate actions to enforce strengths and to reduce weaknesses**

The director supports collaborative efforts. These measures should be intensified.

#### **4.3 Identification of new research topics**

The listed research topics are attractive but it should be critically discussed if in the average about 1-2 researchers (FTE), including PhDs, can really cover one topic.

### **5. DETAILED EVALUATION**

#### **5.1 Declaration on the quality of the results and share in their acquisition**

##### ***Characterisation of the main research activities (experiments, theoretical areas)***

From 2010-14 the work on non-linear systems has been extended. The following topics were briefly presented:

- Analysis and control design for large scale and spatially distributed systems
- Analysis, control design and synchronization of nonlinear chaotic systems
- Invariant manifolds in nonlinear systems; immersion and invariance design
- Topological dynamics and general dynamical systems theory
- optimal control and its applications

All the topics are of current international interest. Considering the small number of scientists at DCT the overall research area is probably too broad.

##### ***Relevance in the national and international context***

International cooperation with the following institutions exists since several years: City University of Hong Kong; CINVESTAV and IPICYT, Mexico; Nagoya University, Japan; IRCCyN Nantes, France, IIASA Laxenburg, Austria. About 15 % of listed publications are an outcome of these cooperations.

The work of the dept. is also recognised by involvement as associate editors in several international high quality journals as well as by the membership in international and national scientific committees.

It should be also mentioned that the previous publications of the dept. were frequently cited during 2010-2014. Also, several staff members became associate editors of international journals during this period.

At the national level DCT mostly co-operates with Czech TU Prague, especially in teaching activities and supervision of students at different levels.

### ***Overall quality of publications***

The DCT lists 88 publications including 27 for bibliometry. Most of the outputs refer to automation and control. In the table “scientific outputs of the team” about 105 publications are listed.

16 papers were evaluated in Phase I from which 6 were ranked as internationally excellent. One of them was considered as world leading.

11 papers were published in the two upper quartiles of AIS of journals.

Based on the figures of research staff at the institute and at the dept. level DCT performs well with respect to number and quality of publications.

### ***Specification of the main achievements***

The main achievements over the last 4 years are in

- Optimization results for bio-systems
- New efficient algorithm for stability analysis and stabilisation of spatially invariant systems
- Efficient numerical methods for the invariant manifold computations with application to various design tasks
- Results on chaos control and synchronization, including study of chaotic networks

## **5.2 Declaration on the involvement of students in research**

During the evaluation period 2 MSc theses and 4 PhD theses were defended under supervision of DCT members. Currently 10 PhD students are under supervision

## **5.3 Declaration on societal relevance**

### ***Impacts of the results and other activities on economy***

Participation in “**Strategy AV 21**” in decentralization of energy generation and its smart transmission; collaboration with Nanazan University, Japan in complex networks and energy Transmission

### ***Impacts of the results and other activities on education***

The DCT members deliver some courses at bachelor, MSc and PhD level at Czech TU, Prague. 4 PhDs successfully defended their thesis during the evaluation period. Currently 10 PhD students are supervised by staff members.

This is seen as a substantial work load for the small number of scientists at DCT.

#### ***Popularisation and similar activities***

The department activities to popularise its results are quite limited.

### **5.4 Declaration on the vitality and sustainability**

#### ***Composition of staff with respect to age and gender, qualification, international experience***

With about 8 FTEs the department is rather small. The age distribution is acceptable because 5 from eleven scientists are below 40 years and 3 above 60 years. Its quality and frequency of publications is quite good but considering that several researchers are above 60 and their input may decrease in the future.

To ensure a sustainable development more full time researchers and PhDs are needed, including foreign scientists. This could be achieved by increasing external funding from grants and cooperation with companies.

It should be mentioned that some female researchers play a very active role in publishing.

### **5.5 Declaration on the strategy and plans for the future**

#### ***Relevance of the out lined strategy and research plans***

The dept. plans to continue its research in

- bio-systems modelling and control
- non-linear dynamical systems and their control based on invariant manifolds
- Chaos and its synchronization.

Rather new topics are in

- Application of complex and nonlinear networks theory
- Systematic research of the theory for virtual constraints in hybrid mechanical systems;
- Experimental verification using robotic walking platform

#### ***Adequacy of available means and human resources to achieve these plans***

It has been already mentioned that with 8 FTEs the staff capacity is rather small. It was also mentioned that raising the income from external grants could be a sound strategy because it would provide options for hiring more researchers.

## EVALUATION OF THE INSTITUTE OF INFORMATION THEORY AND AUTOMATION (UTIA)

### *Team No. 7: Department of Signal Processing (DSP)*

## 1. INTRODUCTION

### 1.1 Brief history of the institute

The dept. was established in 1999.

### 1.2 Mission and research topics

The main mission of DSP is research and design of parallel processing algorithms and also in the design of FPGA (field programmable gate arrays) hardware.

Research topics refer to

- Recursive system identification in digital signal processing (DSP)
- Systolic arrays, dedicated arithmetic, SW & HW
- Field programmable gate arrays (FPGA)
- Dynamically reprogrammable FPGA accelerators
- Embedded systems, human-machine-interfaces (HMI)

### 1.3 Staff size and full time equivalents age distribution

There are some discrepancies in figures about staff size which could not be resolved. According to the submitted tables the staff size is quite small and exhibits a decreasing trend. In 2010 5 FTE researchers, 7,8 (FTE) other staff and 6,85 PhD students worked at DSP. In 2014 2,92 researchers and 0,08 other workers were active. In total 3 FTE.

Table 1: Development of FTEs at the dept. (from 1-4 Personal Structure of Team)

#### Average aggregate FTE of the team's members

|                | 2010 | 2011 | 2012 | 2013 | 2014 |
|----------------|------|------|------|------|------|
| Researchers    | 5,08 | 5,95 | 4,10 | 2,10 | 2,92 |
| Other Workers  | 7,85 | 6,45 | 2,83 | 2,00 | 0,08 |
| (PhD students) | 6,85 | 5,45 | 1,83 | 1,00 | 0,00 |

According to the presentation delivered onsite the personal structure of the team includes in 2015 9 researchers corresponding to 8,5 FTEs. Perhaps these figures refer to 2015.

According to the age structure 3 scientists are between 30 to 40 years while 3 are above 55.

## **2. STRENGTHS AND OPPORTUNITIES**

### **2.1 Timeliness of research topics**

Digital signal processing for recursive system identification and algorithm engineering are quite recent research topics, especially with respect to industrial applications.

The research topics at the dept. are well in line with the AV21 strategy (see Hopes and Risks of the Digital Era).

### **2.2 Budget: Ratio of institutional budget, grants and contractual resources, international funds**

The dept. consumes only a small percentage of the institute's budget and has a coverage of about 95 % from external projects. From 2010-2014 external funding amounts to about 1900 k€, mostly originating from collaboration with the industrial micro-electronics sector and from EU FP6 and FP7 projects. Taking the figures from the institute level (about 2,4 Mio €/a grants and contracts and 105 full time researchers) and comparing them with the respective figures at the dept. level it can be concluded that the external fund raising at DSP is well developed.

However, there remains the uncertainty in staff FTE which has, of course, impacts on the assessment of the specific fund raising level (€/per capita and year).

### **2.3 Intensity of collaboration among teams and among institutes, national collaboration and international involvement**

There exists an intensive collaboration with national and international industrial firms. This is seen as one of the strengths of the dept.. The collaboration within the institute is limited to a few links.

## **3. WEAKNESSES AND THREATS**

The dept. is difficult to evaluate. It is strongly involved in applied research documented by numerous industrial contracts and grants. The AV21 strategy emphasises also applied research.

The number of active researchers is contradicting ranging from 3 FTEs in 2014 to 6 + 3 researchers in 2015. The listed age distribution is rather disadvantageous because of 3 researchers are in the age between 30.40 and 3 above 55.

On the other side, the publication list of the dept. is rather weak and only one paper in a reviewed journal has been published within four years. The overall citation frequency of the dept. publications is also very poor. That is definitely a weak point

## **4. RECOMMENDATIONS**

#### **4.1 Budget: Ratio of institutional budget, grants and contractual resources, international funds**

The management at the institute level should critically revise the budget and staff capacity of the DSP. It looks like that it is understaffed and underfinanced. Considering that the DSP covers about 95 % of its expenditures it would deserve a higher percentage of institutional funding.

#### **4.2 Reasonability of the structure of the institute and the departments**

A general discussion should be started among the institute and the CAS management about the role of depts. engaged deeply in applied research. Obviously, the scientific capacity of DSP is demanded by the industrial sector.

The reviewer is of the opinion that such institutions should be rather seen as a research centre with close links to companies, like the DAR centre. Such institution should be evaluated by criteria with the emphasis on industrial contracts, number of patents, etc. while institution of CAS in fundamental research would have to demonstrate their scientific capacity by an excellent publication record and by high level educational activities.

#### **4.3 Frequency and quality of publications**

It is absolutely necessary that measures are taken to improve the frequency and quality of publications.

### **5. DETAILED EVALUATION**

#### **5.1 Declaration on the quality of the results and share in their acquisition**

##### *Characterisation of the main research activities (experiments, theoretical areas)*

Main focus of DSP is research, development and implementation of advanced digital signal and image processing algorithms, mainly in the fields of telecom, audio processing and processing of high resolution video streams in real time.

DSP exhibits strong experience within the Bayesian approach to recursive identification of linear systems with time variable parameters.

##### *Relevance in the national and international context*

The number of research grants and contracts as well as the amount of acquired financial funds underlines the importance of the dept. in the national and international context.

##### *Overall quality of publications*

6 book chapters, 11 journal articles from which one was in a reviewed journal, and 24 conference papers and 26 reports (applied results) have been elaborated.

In Phase I of the evaluation procedure 10 from 67 outputs were evaluated in detail. None was considered as “world leading” publication but 4 (40%) were classified as internationally excellent.

Surprisingly, none of the papers exhibits a relevant number of citations. This discrepancy (excellent ranking vs. low citation) could be explained by recent publication date.

### *Specification of the main achievements*

Recursive Bayesian system identification provided the basis for solutions in

- Algorithmic engineering of DSP applications
- HW design of intellectual property (IP) for FPGA.

## **5.2 Declaration on the involvement of students in research**

### *Involvement of students (doctoral, undergraduate) into research*

During the evaluation period 9 PhD students were full time employed for two or 3 years. 5 of them defended their PhD thesis successfully (see Tab.2). So, the dropout rate is above 40 % and quite high. Perhaps some of the PhDs have defended their thesis after the evaluation period.

Table 2: Supervised students at DSP

#### **1.1 Supervising students**

| Type of study | No. of supervisors<br>(theses, dissertations) | No. of consultants<br>and co-supervisors | Theses defended<br>in 2010-2014 |
|---------------|---|--|---------------------------------|
| Bachelor      | 0   | 0  | 0                               |
| Master        | 0   | 0  | 0                               |
| Doctoral      | 2   | 0  | 5                               |

Lecture notes for teaching institutions at Brno University of Technology have been elaborated together with online accessible material, but no active involvement in regular teaching activities took place during the evaluation period. Recently, in 2015 some teaching activities have been started.

## **5.3 Declaration on societal relevance**

### *Impacts of the results and other activities on economy*

DSÜ provides strong support of industrial partners to solve implementation issues in all their complexity such as the designing of new DSP algorithms and by exploiting advanced architectural properties of FPGA circuits.

Also, the development of a human machine interface for vehicle control systems is a relevant contribution.

### *Popularisation and similar activities*

No activities were reported.

#### **5.4 Declaration on the vitality and sustainability**

During the evaluation period the dept. has undergone a critical situation as the number of FTEs decreased from about 20 to 3. In 2014 no PhD student was involved in the research activities. For 2015 more promising data were reported.

As mentioned under a previous topic (weaknesses) the publication record is quite small and the citation frequency of publications is negligible.

From the income side the dept. is quite efficient as it covers about 95 % of its costs by external funding. It is also quite well embedded in the applied national and internal research scene.

To ensure the viability of this institutions major measures are required (see recommendations) or a restructuring process should be envisaged to improve the publication record and motivate the staff in teaching activities.

#### **5.5 Declaration on the strategy and plans for the future**

The presentation about future activities does not indicate any major change in the strategy. Contracts and joint projects are ready or already granted. For the period 2015-2017 about 1,1 Mio € are envisaged as income from external funds.

Promotion via an improved dept. homepage is intended, as well as intensification of educational activities.

**Date:** February 28, 2016

**Commission Chair:** em Prof.DI.Dr.Dr.hc. Hans Peter Nachtnebel