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 Czech Academy
of Sciences

 ITAM ARCCHIP
INSTITUTE OF THEORETICAL
AND APPLIED MECHANICS

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EDITORIAL

Dear science lovers, dear readers,

The Institute of Theoretical and Applied Mechanics, CAS wishes to share its results with not only the Science Information Register, but with anyone else interested from among the professional or lay public. This newsletter summarizes the news from June to November 2019 – a short period in terms of scientific life. Even so, there are many results, some of which are presented here.

It is certainly worth mentioning that there is interest in our research results from abroad as well. One such place is the Chinese province of Jiangsu. The second is even more exotic – Iraq. It is a place that is undergoing turbulent geopolitical changes, yet still desires to preserve its cultural heritage gems, which of course need taking care of. How to proceed in the field of restoration was explained to keen Iraqi conservationists by Assoc. Prof. Zuzana Slížková, Ph.D. At home, ITAM received a silver medal for its cooperation with Masaryk University in contributing to education, science and research and their application in society.

For many years, ITAM has been active in the Center of Advanced Materials and Technologies for Protection and Security Improvement. An information workshop with practical demonstrations was organized as part of the project, and as the name suggests, the demonstrations were attractive. These included explosions, structures resistant to them, and ballistic tests. The workshop was attended by representatives of the Government and the Technology Agency of the Czech Republic, which finances the project – not a bad autumn report for ITAM.

I hope you enjoy reading our Newsletter, and that it fills you with interest in future issues.

Stanislav Pospíšil, director of ITAM

EXPLOSIVE AND FIRING TESTS OF CRITICAL INFRASTRUCTURE ELEMENTS

On Thursday, September 12, 2019, the workshop Explosive and Shooting Tests of Critical Infrastructure elements was held in the area of Poličské strojírna. At the workshop the results of a project of the Centre of Advanced Materials and Technologies for Protection and Security Improvement were presented by Ing. Martin Šperl, Ph.D. who attended the event as a representative of our institute and the main ITAM investigator [manager] for the project. Within the project, ITAM was responsible for solutions in the protection of buried infrastructure elements from dynamic threats. cont. at p.2

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A SCIENTIST FROM ITAM LECTURED IN IRAQ



Lecturers in Iraq. Author: National Heritage Institute

In September 2019, Assoc. Prof. Zuzana Slížková, Ph.D., Head of the Department of Materials Research at ITAM CAS, joined a delegation of lecturers attending an educational program for Iraqi conservationists at the Iraqi Institute for the Conservation of Antiquities and Heritage (IICAH) in Erbil. The educational program was coordinated by the National Heritage Institute (NHI) as part of a government program to support Czech participation in the stabilization and reconstruction of Iraq.

Among the lecturers of the course called Causes of Degradation, and Conservation of Historical Building Monuments were experts from the NHI, as well as staff of various institutes of the Czech Academy of Sciences, the Faculty of Restoration of Pardubice, the Faculty of Philosophy of Palacký University Olomouc, and the restoration company Gema Art International.



Author: NHI

B. Přečová

The aim of the event was to present to stakeholders the latest results of research and development projects of the Ministry of Interior, the Ministry of Defence and the Technology Agency of the Czech Republic in the field of critical infrastructure (CI) protection.



Practical demonstrations were carried out in an explosion pit and at the shooting range, and included tests of wall and waste-bin resistance to explosions, the protection of objects against attacks by anti-tank hand grenades, and the ballistic testing of walls. The tests were followed by a presentation of newly developed CI protection elements: walls protective against explosions, projectiles and fragments, modular shelters for personal protection, and road-traffic barriers. The event was held under the auspices of the Czech Defence Minister, the Interior and the Chairman of the Technology Agency of the Czech Republic.

B. Přečová

WORKSHOP: LIME AND SAND

On October 10th and 11th 2019, the Department of Lime Technologies hosted a workshop entitled *Lime and sand – the universal material of historical buildings and their decorations*. The event focused on the raw materials used in the production of mortars, plasters and stucco; especially lime, sand and

gypsum, methods for processing them and practical application. The introduction was held at VOPŠ Svatojánská kolej in Sv. Jan pod Skalou where contributions were presented on historical methods of lime production, the development of lime technologies, the properties and varieties of raw materials usable in the production of building-lime, and raw-material sources available in the Czech Republic. During the second lecture block there was a presentation of the procedure chosen for the study and reconstruction of Renaissance sgraffito in Slavonice and Baroque stucco at Červená Lhota Castle.



Practical demonstration of low-temperature plaster firing

The practical part took place at the Experimental Center for Traditional Lime Binders in the Solvay Quarries near Bubovice. Here, there were demonstrations of the filling of a historic lime kiln, the preparation of traditional lime burning with wood, and low-temperature plaster firing. Furthermore, three different methods of slaking quicklime were shown. The Friday program was focused on demonstrations of materials and procedures used in the creation of sand and charcoal sgraffito and plaster-lime stucco decorations. The concluding lecture given by archaeologist Jana Maříková-Kubková and historian Marek Suchý was a great contribution to the event as a whole. It was dedicated to the presentation of a publication, which maps more than 1000 years of the history of the Cathedrals of St. Vitus, Wenceslas, Adalbert and The Virgin Mary at Prague Castle.

P. Kozlovce

FOTOMETRIC STEREO - "HAT" AND ITS FOLLOWERS

At the Department of Diagnostics and Conservation of Monuments we have been focusing long-term on the recording and presentation of information on studied objects and artefacts using in particular optical methods, IR, UV and laser scanning. While developing our first patented device for coded photometric stereo, informally called the "Hat", we focused on ease of use during in-situ testing; the device is light, compact and battery powered. What is unique here is the use of a so-called Bayer filter – a colour RGB mosaic placed in front of the camera element. Three images, illuminated from different angles by RGB lights, can be obtained from a single photograph. A reconstructed surface can be "coated" with a texture obtained from a second photograph in white light using the built-in LED ring. Further development focused on stationary devices (see figure), the emphasis being on removing compromises.



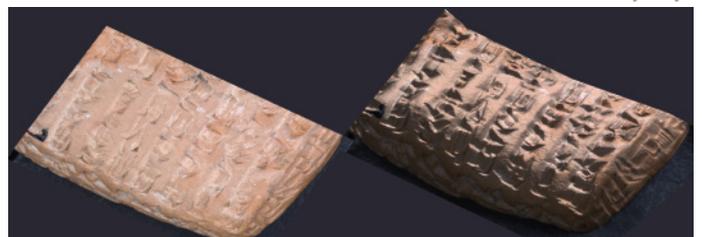
Left: mobile version, right: cabinet version

Collinear light sources are used, including one with a moiré lattice for easier transformation to real dimensions. Any digital SLR camera can be used for capturing the images, and the use of larger lenses is also possible, significantly contributing to the range of technical capabilities of the device.

The computer-controlled stage has three degrees of freedom and is itself attached to a swivel base. Furthermore, the vertical movement of the camera is motorized, as are the main white-light sources in two axes and the LED ring. The movements, lights and camera are all operated via a control unit, a PC with a touch screen and a gamepad (for convenient navigation over the sample).

The robustness and configurability of a cabinet is great for laboratory work. However, the practical requirements of 3D digitization, e.g. in museums, have led to the development of an easily demountable device combining a "lightbox" – a cube with uniform illumination with an "umbrella" housing spherically-evenly-spaced lighting elements, applying a wider range of techniques to achieve a faithful 3D reconstruction.

J. Bryscejn



WITH RADEK ŠEVČÍK ABOUT OPEN SCIENCE INTERNSHIPS

In this issue we bring you an interview with our colleague Radek Ševčík, an Open Science lecturer, who works at the Centre Telč in the Department of Materials Research and led an internship this year called *CaCO₃ Synthesis in the presence of inorganic additives*. His interns won first prize at the final Open Science Student Conference 2019 for the presentation of their results.

We cannot omit the interview with the trainees themselves: Tadeáš Fejfar, Justýna Melánie Přečová and Lukáš Dvořák.



Interns with their lecturer Radkem Ševčíkem

What was the deciding factor for you to get involved in OS?

The reason I got involved was to have the opportunity to interact with secondary-school students, to show them what scientific work is about and, last but not least, to raise awareness of our unique workplace in Telč.

What does such an internship look like? And how did you decide on a topic?

I tried to make the internship attractive, giving the students a chance to try out using a number of instrumental methods such as automatic titration, X-ray diffraction, and electron microscopy. An integral part was also evaluating the acquired data and working with academic literature.

The theme I chose was based on my favourite scientific topic, which is investigation of calcium carbonate formation. The students were tasked with preparing calcium carbonate under various conditions from salt solutions and in the presence of additives, and to perform basic characterizations of the precipitates formed.

How satisfied are you with the interns? :)

Despite the rather demanding internship program, I have to commend the students. They were able to familiarise themselves with the instrumentation in a relatively short time, and were able to actively participate in the obtaining of results which they will present at the OS conference in Prague (*the interview took place before the Conference*).

This year's internship is slowly coming to an end. If you were to make an assessment: what did the internship bring you? I ask because a lecturer devotes a lot of time to trainees, which may then be lacking elsewhere, and the undeniable social benefits can take time to show.

I certainly do not regret my involvement in OS, despite the time it takes up. I enjoyed leading the students, and I think the students were also satisfied with the internship. Regarding the social benefits, one has already been fulfilled, namely acquainting the students with scientific work and giving them the opportunity to regularly visit a scientific workplace. Perhaps I managed to show them the charms of scientific work, and in the future they will not abandon science. Regarding the specific scientific outcomes of the internship, I believe it will serve as a basis for further research and development of scientific methods.

Would you participate in OS again? What would you recommend colleagues who still hesitate to join OS?

Certainly. In case high school students are interested, they can apply to the newly announced topic. Other colleagues also showed interest in the OS program, as evidenced, for example, by the launching of a new topic by Dr. Viani.

B. Přečová

INTERNS

What made you choose this particular internship?

Tadeáš: My hobbies being chemistry and physics played a big part in my selection. I chose this internship as a great opportunity to learn something new and a chance to try out scientific work. Also the location was decisive as the research facility, CET, is only a few tens of meters from my place of residence.

Justýna: For me, the subject was definitely the deciding factor. I wanted to try an internship on the border of physics and chemistry, because I am very interested in these two fields. A big plus is also the fact that the workplace at which I did my internship is located in Telč, where I go to school.

How did you like the internship, and what did it teach you?

Tadeáš: I really liked the internship, and it was a great experience for me. It taught me all different kinds of things not only in the field of calcium carbonate synthesis, but also how various instruments work, and how to operate and work with them, for example the scanning electron microscope, X-ray diffraction analysis, etc. It was also a great opportunity for me to learn how to work in a research environment. I had a chance to meet a lot of wonderful people from all over the world, to have a lot of fun, and to practice English.

Justýna: I learned to operate many of the instruments needed for research. I would like to highlight, for example, work with the electron microscope. I still find it incredible that we can see materials at such a huge magnification. Among other things, the internship taught me how to work on a scientific team. It was nice to meet people of the same age with the same interests.

Lukáš: The internship exceeded my expectations. I can feel my improvement in the field of chemistry, and also working in a collective.

Did the internship help you decide what you would like to pursue in the future?

Justýna: Not exactly. It was certainly a valuable experience, but I have already been decided for a long time that I would like to work in the academic world. This just reinforced my decision.

Tadeáš: The internship definitely deepened my interest in chemistry and physics, and strengthened my decision to pursue science. However, I was already determined to study dentistry before I applied.

Lukáš: I think the internship will definitely help me with my decision making.

So, are you planning to work in science in the future? Do you now have a better understanding of what such work entails?

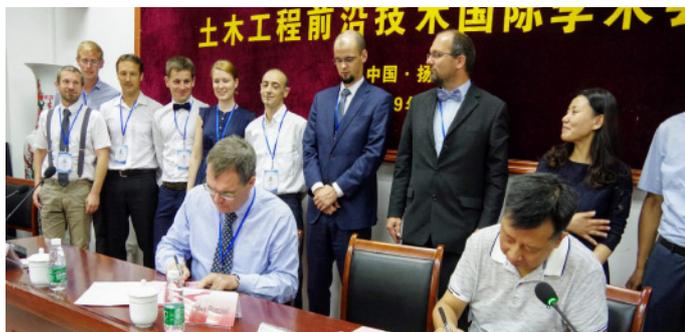
Lukáš: Absolutely.

Tadeáš: Certainly yes. Scientific work is very interesting and there is always something new to explore. Personally I would like to do research work in the field of dentistry. The only pitfall I see is the occasional routine work, but I believe I can cope with it.

Justýna: I would like to work in science, and now I know what such work entails. For example, it is not only about research, but also about writing scientific articles and analysing the findings of other scientists which could help us with the issues we are investigating.

B. Přečová

MEMORANDUM WITH YANGZHOU UNIVERSITY



A ten-member delegation from ITAM CAS had the opportunity to visit Yangzhou University (YZU) in Jiangsu Province, China, from September 7th-13th, 2019. During the visit to the University, the representatives of ITAM met with academic staff of the Faculty of Civil Engineering and gave lectures at the International Conference on Advanced Technology in Civil Engineering. On the occasion of the opening of this two-day conference, the director of ITAM CAS, Assoc. Prof. Stanislav Pospisil, Ph.D. and the Deputy Rector of the Yangzhou University signed a Memorandum of Understanding between YZU and ITAM CAS. Among other things, the Memorandum contains arrangements for future academic cooperation in the form of scientific and technical staff exchange, consultations, co-hosting of scientific conferences, student exchange programs, etc.

B. Přečková



AWARD FOR COOPERATION WITH MASARYK UNIVERSITY

At the celebrations of the 100th anniversary of its founding, Masaryk University (MUNI) acknowledged its partners who have contributed or contribute significantly to the activities of its faculties, non-faculty institutions or the university as a whole. A total of 99 partners nominated by faculties and other university departments were awarded the Silver Commemorative Medal of Masaryk University for their contribution to education, science and/or socially relevant research. Among the awarded, ITAM CAS was represented twice. The medal ceremony took place on Thursday the 13th of June at the Augustinian Abbey in Brno.

Professor Miloš Drdáký received a medal for co-authoring the idea of creating a Central European Centre for Cultural Heritage at the University Centre Telč (UCT) of Masaryk University.

ITAM CAS, Centre Telč received a medal for its partnership with the Central European Centre in Telč - a key condition in the granting of a subsidy for the overall reconstruction of the UCT in 2009-11 - and also for its active partnership in the Scola Telcz project.

The Centre Telč was also presented alongside UCT MUNI and the National Heritage Institute as a part of the exhibit of the Central European Centre for Cultural Heritage at the MUNI100 festival which took place on Saturday, June 15 at the Brno Exhibition Centre. Despite the very warm weather, nearly ten thousand people arrived at the event.



DR. JIŘÍ NÁPRSTEK RECEIVES HONORARY FELLOWSHIP FROM IIAV

The IIAV is part of the Auburn University in Alabama, and is one of the foremost American scientific institutions in the field of acoustics and system dynamics. The Honors and Awards Committee of the IIAV has elected 17 experts from around the world to become Honorary Fellows. The diplomas will be personally awarded by the President of the Institute at the opening of the 27th International Congress on Sound and Vibration (ICSV27) which will take place in Pra-gue in July of 2020. The number of participants is expected to reach up to 1300, and J. Náprstek will be acting as co-chairman of the Congress. The main task of a newly elected Honorary Fellow is to give a plenary lecture before the congress on a topic agreed upon by the President of the IIAV.

In addition to the above, J. Náprstek has recently earned another distinction for his work. He was elected a member of the Advisory Committee of the International EUROMECH Association and elected to the Steering Committee of the International Association for the Organization of ICOVP Congresses.

And finally, all of us at ITAM CAS congratulate Jiří Náprstek on his 75th birthday. We wish him all the best, both in personal and professional life.