Jednota slovenských matematikov a fyzikov
Pobočka Košice

Prírodovedecká fakulta UPJŠ
Ústav matematických vied

Fakulta elektrotechniky a informatiky TU
Katedra matematiky a teoretickej informatiky

17. Konferencia košických matematikov

Herľany
6. – 9. apríl 2016

Jednota slovenských matematikov a fyzikov
Pobočka Košice

Prírodovedecká fakulta UPJŠ
Ústav matematických vied

Fakulta elektrotechniky a informatiky TU
Katedra matematiky a teoretickej informatiky

17. Konferencia košických matematikov

Herľany
6. – 9. apríl 2016

Konferenciu finančne podporili:

ZSVTS – Zväz slovenských vedeckotechnických spoločností a
SSAKI – Slovenská spoločnosť aplikovanej kybernetiky a informatiky.

Editori: Ján Buša, Jozef Dobo\v{s}

ISBN 978-80-553-2542-2

Sadzba programom pdfTEX

Predhovor

Vážení priatelia, milí hostia, kolegyne a kolegovia,

vitajte na 17. Konferencii košických matematikov. Túto konferenciu organizuje Jednota slovenských matematikov a fyzikov, pobočka Košice, v spolupráci s Ústavom matematických vied Prírodovedeckej fakulty UPJŠ, katedrami matematiky Technickej univerzity a pobočkou Slovenskej spoločnosti aplikovanej kybernetiky a informatiky pri KRVP BF TU v Košiciach. Konferencia sa koná, tak ako aj jej predchádzajúce ročníky, v útulnom prostredí Učebno-výcvikového zariadenia TU Košice – v Herľanoch.

Nápad organizovať konferenciu tohto typu vznikol v našej pobočke JSMF pod vedením prof. Jendroľa pred viac ako šestnástimi rokmi. Bola za tým myšlienka, že ľudia profesionálne sa zaoberajúci matematikou v jej rôznych podobách (učitelia, vedci, aplikovaní matematici) a žijúci na východe Slovenska by mali mať možnosť sa pravidelnejšie stretávať, podeliť sa s rovnako „postihnutými“ kolegami o svoje radosti i starosti súvisiace s prácou matematika či matematikára; následne spoločne alebo s ďalšími spriaznenými dušami hľadať riešenia či východiská z problémov. Prípadne si vzájomne pomáhať a povzbudiť sa navzájom. Ďalej to bola predstava, že by malo ísť o serióznu konferenciu s kvalitným obsahom, najmä pozvanými prednáškami. Od začiatku boli na ňu pozývaní prednášajúci s cieľom, aby to boli či už zrelé alebo práve vychádzajúce kvalitné osobnosti, známe vo svojom prostredí, s cieľom dozvedieť sa nové veci, nadviazať nové či upevniť staré kontakty. Viaceré z týchto prednášok mali taký pozitívny ohlas, že ich autori boli pozvaní prednášať aj na iných konferenciách.

To, že Konferencia košických matematikov sa koná po 17. krát je len potvrdením, že tieto myšlienky našli úrodnú pôdu. Každoročne sme na nej mali skvelých prednášajúcich. Na výbere a príprave konferencie sa pracuje celý rok. O výbere pozvaných prednášajúcich sa v podstate rozhoduje na tradičnom každoročnom stretnutí výboru košickej pobočky JSMF s košickými profesormi matematiky a vedúcimi košických matematických pracovísk, vrátane riaditeľa Gymnázia na Poštovej ulici, ktoré má matematické triedy.

Za tých 17 rokov sa vykryštalizovala aj štruktúra konferencie. Prvé dva dni (streda a štvrtok) sú venované najmä mladým začínajúcim matematikom. Mnohí dnes už veľmi úspešní kolegovia mali svoje prvé verejné odborné či vedecké vystúpenie práve na našej konferencii. Vystúpenia mladých kolegov majú z roka na rok vyššiu úroveň, čo organizátorov veľmi teší. V piatok a v sobotu dopoludnia sa konajú najmä pozvané prednášky, aby sa na nich mohlo zúčastniť čo najviac účastníkov. Spoločenský piatkový večer je organizovaný tak, aby bolo možné v menších skupinách pri pohári vínka predebatovať rôzne otázky.

Aj tento rok sa nám podarilo získať viacero výrazných osobností. Pozvanie prednášať prijali: doc. RNDr. A. Ferko, CSc. (KI FMFI UK

Bratislava), RNDr. R. Hajduk, PhD. (CCVaPP UPJŠ Košice), doc. RNDr. R. Jajcay, PhD. (KAGaDM FMFI UK Bratislava), M. Kirchmayer (MATSUKO s r.o. Košice), doc. RNDr. S. Lukáč, PhD. (ÚMV PF UPJŠ Košice), prof. RNDr. J. Molnár, CSc. (KAaG PF UP Olomouc) a RNDr. P. Olšák (KM FE ČVUT Praha).

Prajeme vám príjemný pobyt v Herľanoch

Organizačný výbor: Ján Buša
Jozef Doboš
Róbert Hajduk

Obsah – Contents

Invited lectures

Questionable Questions

Andrej Ferko and Martina Bátorová

Department of Informatics, FMP&I Comenius University, Bratislava, Slovakia

We present an authoring method how to create locally and globally interesting teaching in a relatively short time. E.g., "What are the asymptotes of an ellipse?" For creating such questionable questions, we discuss the uncertainty categorization by Jan Haluska. The overview of necessary notions includes virtual time, bisociation, energy of mistake, depth of immersion, and enthymeme. The conceptual model comes from virtual museum research. We present and discuss the usability of the approach in a case study, teaching polygon triangulation using wrong metaphors.

References

[1] Forišek, M. and Steinová, M.: *Explaining Algorithms Using Metaphors,* Springer Briefs in Computer Science, 2013.

[2] Glassner, A.: *Interactive Storytelling: Techniques for 21st Century*, Fiction. AK Peters, 2004.

[3] Haluska, J. *The Mathematical Theory of Tone Systems,* New York: Marcel Dekker, Inc., 2004.

[4] Koestler, A.: *The Act of Creation,* Penguin Books, 1964.

[5] Lakoff, G. and Johnson, M.: *Metaphors We Live By,* University of Chicago Press, Chicago, 2003.

[6] Polya, G.: *How to Solve It,* Garden City, NY: Doubleday: 253, 1957.

[7] Preparata, F. P. and Shamos, M. I.: *Computational Geometry: An Introduction,* New York: Springer-Verlag, 1985.

[8] Sellares, J. A. and Toussaint, G.T. On the role of kinesthetic thinking in computational geometry. Journal of Mathematical Education in Science and Technology, Vol. **34**, Num. 2, 219–237, 2003.

40 years of Correspondence Mathematical Seminars (Not Only) in Eastern Slovakia

Robert Hajduk

Life-Long Learning Center and Projects Support, University of Pavol Jozef Šafárik in Košice, Šrobárova 2, 041 80 Košice

Correspondence math seminars have a long tradition in educating mathematically gifted pupils in Slovakia and the Czech Republic. This year it is 40 years when the first mathematical seminars start in Košice. Seminars provide a suitable, alternative form of education leading to improvement of the pupils interested in mathematics. Nowadays, to develop his talent, a student needs stable stimuli which will develop his curiosity and desire for new knowledge. Moreover, help him develop his talents and interests. This is the primary goal of correspondence seminars. Seminars also shape the personality of students in a very sensitive developmental period of adolescence.

In the talk, we show the genesis of correspondence math seminar in eastern Slovakia and in the other part of Slovakia and Czech Republic. We will be presented memories on the first camps, series of math problems and the benefits of developing young talented students.

Improving Moore Bounds by Counting Cycles

Robert Jajcay

Katedra algebry, FMFI UK, Mlynská dolina, 842 48, Bratislava

The *Cage Problem* is a problem from extremal graph theory that calls for finding k-regular graphs of girth g of smallest possible order $n(k,g)$ for any given parameter pair (k,g), $k \geq 2, g \geq 3$. Graphs of degree k and girth g (called (k,g)-graphs) of order matching $n(k,g)$ are called *cages*.

The *Moore bound* $M(k,g)$ is a lower bound on the order $n(k,g)$ of (k,g)-cages based on a relatively simple counting argument. Even though the Moore bound is known to be sharp, i.e., parameter pairs (k,g) are known

(and classified) for which $n(k,g) = M(k,g)$, this only happens for very restricted families of parameters, and $n(k,g)$ is strictly greater than $M(k,g)$ for an overwhelming majority of k's and g's. The exact value of $n(k,g)$ is unknown except for some small cases, and the best known constructions differ from the Moore bound by a significant amount running very quickly into multiples of the Moore bound.

Despite the widely accepted belief that the Moore bound is a poor predictor for $n(k,g)$, only very few improvements on the Moore bound have been found, with the best results showing $n(k,g) \geq M(k,g)+4$ (for specific values of k and g).

In our talk, we present a survey of the known lower bounds for $n(k,g)$ and introduce a technique based on counting cycles of lengths close to g in potential (k,g)-graphs that leads to some simple arithmetic criteria that (sometimes) allow us to exclude the existence of (k,g)-graphs of orders close to the Moore bound. The presented results are based on the recent articles [1] and [2].

Acknowledgement. The presented work was supported by the Slovak VEGA 1/0577/14, VEGA 1/0474/15, NSFC 11371307, and by the Slovenian Research Agency (research project J1-6720).

References

[1] T.B. Jajcayová, S. Filipovski and R. Jajcay: *Counting cycles in graphs with small excess*, submitted for publication.

[2] T.B. Jajcayová, S. Filipovski and R. Jajcay: *Improved lower bounds for the orders of even girth cages*, submitted for publication.

How Mathematics Empowers Game Creators

Matúš Kirchmayer

MATSUKO, s.r.o., Košice, Slovakia

Mathematics aim to model our living world and to describe its rules. This presentation explains how the computer games aim to exploit these models in the simulation of virtual universes. Building computer games is literally being able to create worlds and to create live within these worlds. "Fantasy is the impossible made probable. Science Fiction is the improbable made possible."

Development of Inquiry Skills in Mathematics Teaching

Stanislav Lukáč

Institute of Mathematics FSc, Pavol Jozef Šafárik University,
Jesenná 5, 041 54 Košice, Slovakia

The OECD's Programme for International Student Assessment (OECD PISA) 2012 has indicated a decrease in the level of students' knowledge and skills in some areas. This is an overall trend, not just in Slovakia. Unsatisfactory results and a decline in interest in learning mathematics encourage a search for ways of motivating students to acquire knowledge and skills actively. Inquiry-based education has now an important position among the innovative trends in mathematics and science education. At the Faculty of Science, UPJŠ in Košice, we deal with a project supported by the APVV called Research on the efficiency of innovative teaching methods in mathematics, physics and informatics education. The project is focused on the application of active students' inquiry into teaching mathematics, physics and informatics at secondary schools and on the assessment of the effectiveness of these innovative teaching methods.

Young people should acquire inquiry skills such as collecting and analysing data, interpreting results, drawing and justifying conclusions especially in the learning of mathematics and science. In this contribution, we describe the classification of the inquiry skills and some activities for stimulation of the development of students' inquiry skills in mathematics teaching. The created methodical and teaching materials have been used in a pedagogical experiment conducted at selected secondary schools in the school year 2015/2016. The pre-test given to students at selected secondary schools in the first phase of the pedagogical experiment is designed to evaluate the level of development of selected inquiry skills. Partial results from the evaluation of the pre-test and samples of students' solutions of tasks obtained during the implementation of the pedagogical experiment are also presented in this contribution.

Acknowledgment. This work was supported by the Slovak Research and Development Agency under the contract No. APVV-0715-12.

References

[1] Banchi, H., Bell, R.: *The many levels of inquiry,* in Science and Children, 46, 2008, pp. 26–29.

[2] Rivera, F., D.: *Toward a Visually-Oriented School Mathematics Curriculum. Research, Theory, Practice, and Issues,* Springer, 2011, p. 311. ISBN 978-94-007-0013-0.

[3] Van Den Berg, E.: *The PCK of Laboratory Teaching: Turning Manipulation of Equipment into Manipulation of Ideas,* Scientia in educatione, 2013, vol. 4, iss. 2, 74–92. ISSN 1804-7106.

[4] Wenning, C.J.: *Assessing inquiry skills as a component of scientific literacy,* Journal of Physics Teacher, Education Online, 4(2), 2007, 21–24.

The CTUstyle TEX Template for Student Theses at CTU in Prague

Petr Olšák

Department of Mathematics, FEE, Czech Technical University in Prague, Technická 2, 16627 Praha 6, Czech Republik

The CTUstyle template is used at the Czech Technical University in Prague (CTU). This template is based on plain TEX macros and OPmac macro package.

Several students started to use my CTUstyle template and many of them complimented me that the template has a good design and it is simple to use. I want to emphasize that many of these students had no previous knowledge about TEX nor LATEX, but they were able to simply use this template. This is contrary to the opinion that LATEX is simpler to apply than plain TEX at the user level. This is not true when a good template is available.

Main principles of the CTUstyle template and the OPmac package will be introduced in the talk.

Conference contributions

The Effects and Consequences of the Content Reform of Education on the Students of Technical Universities

Beatrix Bačová

Faculty of Civil Engineering, University of Žilina, Slovakia

Media, parents as well as professional public are trying to answer the question whether indeed the latest school reform in Slovakia known as the Content Educational Reform (started on 1/9/2008) has been bringing the expected results. Changes in the educational program have touched the pupils of the first and fifth forms of primary schools and the first form of secondary schools. After seven years of the reform introduction into practice and the appointment of the fifth Minister of Education one of the major changes that have become the parts of a new learning process is a greater focus on its output. Some of the results of the reform can already be analysed and compared (and so we can already speak about the consequences and impacts of the reform). However, the final results and impacts of the reform will be fully apparent not sooner than in 10–20 years.

The ongoing educational reform puts the emphasis on the content of education. Therefore state educational programs as well as the framework curriculum have been adapted to this fact. The reform changes have influenced existing subjects but also the newly created ones. Each primary and secondary school could create its own content of individual subjects. The only requirement was to comply with the minimum curriculum – compatibility of minimum curriculum at all schools had to be preserved. The minimum content is defined by the content part of the educational standards. In addition to "standard subjects" which the pupils or students had the opportunity to study before, new subjects (e.g. media education, multicultural education, business education, financial literacy, etc.) were added. Strengthening several existing subjects by adding more lessons a week for the students resulted in the reducing of the number of lessons a week of

other subjects (such as mathematics). Has this reduction of the number of mathematics lessons (mainly at the secondary schools) influenced their knowledge necessary for studying at the university?

We have compared the surveys conducted on the students of the 1st form of BC studies who were studying Mathematics 1 and Mathematics 2. In the academic years 2010/2011, 2014/2015 and 2015/2016 we conducted the survey related to Mathematics 1 and in the academic years 2010/2011 and 2014/2015 the survey related to Mathematics 2. Both surveys included the students who have not undergone the reform yet as well as the students who have entered the university after the introduction of the reform into practice. In the surveys not only students' attitudes to mathematics but also their achievements in Mathematics 1 and Mathematics 2 have been compared.

If the proposed changes in education are to be successful, the actual management of the educational sector as well as all other responsible people should discuss these issues with the general public, i.e., with teachers, pupils, students and their parents.

Key words: reform, educational level, Mathematics, English

(F,H)-WORM Colorings of Plane Graphs

Július Czap, Stanislav Jendroľ, and Juraj Valiska

Institute of Mathematics FSc, Pavol Jozef Šafárik University, Jesenná 5, 041 54 Košice, Slovakia

Given three planar graphs F, H, and G. An (F,H)-WORM coloring of G is a vertex coloring such that no subgraph isomorphic to F is rainbow and no subgraph isomorphic to H is monochromatic. If G has at least one (F,H)-WORM coloring, then $W^-_{F,H}(G)$ denotes the minimum number of colors in an (F,H)-WORM coloring of G. We show that

a) $W^-_{F,H}(G) \leq 2$ if $|V(F)| \geq 3$ and H contains a cycle,

b) $W^-_{F,H}(G) \leq 3$ if $|V(F)| \geq 4$ and H is a forest with $\Delta(H) \geq 3$,

c) $W^-_{F,H}(G) \leq 4$ if $|V(F)| \geq 5$ and H is a forest with $1 \leq \Delta(H) \leq 2$.

We also discuss the remaining cases. The cases when both F and H are nontrivial paths are more complicated; therefore we consider a relaxation of the original problem. Among others, we prove that any 3-connected plane

graph (resp. outerplane graph) admits a 2-coloring such that no facial path on five (resp. four) vertices is monochromatic.

Presentation Templates in LaTeX

Jozef Doboš

Institute of Mathematics FSc, Pavol Jozef Šafárik University, Jesenná 5, 041 54 Košice, Slovakia

A LaTeX template for presentations via a document class beamer will be introduced. Moreover, a different approach to slides in LaTeX without using the beamer class will be discussed and the two approaches will be compared and contrasted.

Acknowledgment. This work was supported by the Slovak Research and Development Agency under the contract No. APVV-0715-12.

Graph Colouring Concepts of Thue Type

Erika Fecková Škrabuľáková

Institute of Control and Informatization of Production Processes, Faculty BERG, Technical University, Němcovej 3, 040 22 Košice, Slovakia

Axel Thue was famous Norwegian mathematician known for highly original work in combinatorics. Not only the programming language Thue is named after him. There are some graph colouring problems that came to be called with his name.

Here we give a long (but still not complete) list of these problems (see, e.g., [1], [2], [3], [4], [5], [6], [7], [8]), show the differences between them, as well as an overview of some known results in the area. This will be supplemented by several open problems.

Acknowledgement: This work was supported by the Slovak Research and Development Agency under the contract No. APVV-14-0892, this work was supported by the Slovak Research and Development Agency under the contract No. APVV-0482-11, by the grants VEGA 1/0529/15, VEGA 1/0908/15 and KEGA 040TUKE4/2014.

References

[1] N. Alon, J. Grytczuk, M. Hałuszczak, O. Riordan, Non-repetitive colourings of graphs, Random. Struct. Algor. 21, 336–346 (2002).

[2] J. Barát, J. Czap, Facial nonrepetitive vertex coloring of plane graphs, Journal of Graph Theory 77, 115–121 (2013)

[3] F. Havet, S. Jendroľ, R. Soták, E. Škrabuľáková, Facial non-repetitive edge colouring of plane graphs, Journal of Graph Theory 66, 38–48 (2011)

[4] J. Kok, E. Škrabuľáková, N. Sudev: On new Thue colouring concepts of certain graphs, Submitted manuscript, (2016)

[5] J. Przybyło, J. Schreyer, E. Škrabuľáková, On the facial Thue choice number of plane graphs via entropy compression method, arXiv preprint arXiv:1308.5128, 1–13 (2013)

[6] J. Schreyer, E. Škrabuľáková, On the facial Thue choice index of plane graphs, Discrete Mathematics 312, 1713–1721 (2012)

[7] J. Schreyer, E. Škrabuľáková, Total Thue colourings of graphs, European Journal of Mathematics 1(1), 186–197 (2015)

[8] Y. Zhong, X. Zhu, Fractional Thue chromatic number of graphs, manuscript, 1–16 (2013)

About the Differences between Student Self-Assessment and Teacher Assessment in Selected Topics of School Mathematics

Timea Gábová

Institute of Mathematics FSc, Pavol Jozef Šafárik University, Jesenná 5, 041 54 Košice, Slovakia

The recent school reform has increased emphasis on the formative assessment and its integration. Unfortunately, the self-evaluation as part of the formative assessment is still infrequently used, so it needs to be more integrated into teaching and thus develop future goals of students who can effectively teach using the self-assessment.

So we decided, using the self-assessment questionnaire developed to school test, analyze the differences between the self-assessment of a student and assessment of school test by a teacher. Using this analysis, we

further explored these differences using the qualitative research, specifically using controlled interview and we examined pupils' opinions on the inclusion of the self-assessment in teaching.

Structure of Plane Graphs with Minimum Degree 2

Peter Hudák, Mária Maceková, Tomáš Madaras, Pavol Široczki

Institute of Mathematics FSc, Pavol Jozef Šafárik University, Jesenná 5, 041 54 Košice, Slovakia

Let $G = (V, E, F)$ be a connected plane graph. For an edge $e = xy$ the weight of an edge e is the sum $w(e) = \deg(x) + \deg(y)$. The minimum vertex degree of G we denote by $\delta(G)$, and the minimum edge weight of G we denote by $w(G)$. The minimum face size of G we denote by $\rho(G)$ and the minimum dual edge weight of G is the number $w^*(G) = \min\{d(\alpha) + d(\beta) : \alpha, \beta \in F,\ \alpha \neq \beta,\ \alpha, \beta \text{ have a common edge}\}$.

We study the families of plane graphs with $\delta(G) = 2$ determined by lower bounds ρ, w, w^* on their face sizes, edge weights and dual edge weights, respectively.

Continuing the previous research of such families comprised of polyhedral graphs ($\delta(G) \geq 3$), we determine the quadruples $(2, \rho, w, w^*)$ for which the associated family is non-empty. In addition, we determine all quadruples which yield extremal families (in the sense that the increase of any value of a quadruple results in empty family of graphs).

When Pupils Understand a Task Otherwise Than Its Creators...

Jana Chudá

Institute of Mathematics FSc, Pavol Jozef Šafárik University, Jesenná 5, 041 54 Košice, Slovakia

In the paper we deal with a task, the assignment of which was formulated in a fuzzy way. It is task about two touching circles inside of a rectangle. Based on the authentic pupil's solutions we try to describe what caused the ambiguity of this task. We provide two correct modified assignment of this task. At the end we present our recommendation for teachers and pupils how to solve and how to assess similar tasks.

From Descartes' Rule of Signs to the Fastest Algorithm for Isolating Polynomial Roots

Irena Jadlovská

Department of Mathematics and Theoretical Informatics, Technical University, Němcovej 32, 04200 Košice, Slovakia

Based on the work of Fourier, the famous Sturm's algebraic theorem announced in 1829 provides an elegant way to count the number of real roots of any polynomial equation over a given interval. Over the next fifty years, the theorem was the only one widely known and used, before being replaced by revisited versions of almost forgotten Vincent's 1836 theorem.

In fact, the exponential behavior of the original Vincent's algorithm has been overcome by Akritas and Collins, whose modern bisection version has actually been implemented into major computer algebra systems.

This talk aims to briefly discuss the mathematical background of related root isolation methods as well as outgoing directions for future research.

How to Attract Generation Z in Mathematics Class?

Iveta Kohanova

Department of algebra, geometry and didactics of mathematics, Faculty of mathematics, physics and informatics, Comenius University in Bratislava, Slovakia

Mobile learning is characterized as any form of learning that takes place via mobile devices or with their support [1]. It is anywhere, anytime learning enabled by instant, on-demand access to a personalized world filled with the tools and resources we prefer for creating our own knowledge, satisfying our curiosities, collaborating with others, and cultivating experiences otherwise unattainable [2]. Mobile learning implies adapting and building upon the latest advances in mobile technology, redefining the responsibilities of teachers and students, and blurring the lines between formal and informal learning. Current students, who are recognized as generation Z, are the most technologically advanced generation, often known as digital natives. They were born into the era of the Internet and Facebook; they are addicted to their smartphones and very reluctant to give them up during classes. Traditional teaching methods do not address them and this was one of the reasons why we have developed mathematical applications for mobile devices and tried to use them during mathematics classes. Mentioned applications were implemented and developed as a part of Slovak-Norwegian project Apps in Math (`www.project-aim.eu`) and have character of Game-Based Learning Apps [3]. In the research we studied whether students understood and learnt the new concepts and procedures only by using our mathematical application. From the first test results it is evident that most of the students achieved very good score. Further testing and development will show whether mobile learning is an effective form of education, which not only improves pupils' knowledge, but also attitudes toward mathematics.

Acknowledgement. This study was supported by project Apps in Math (SK06-IV-01-006), which is co-funded by the EEA Grants and the state budget of the Slovak Republic from the EEA Scholarship Program Slovakia.

References

[1] Neumajer, O., Rohlíková, L., Zounek, J.: *Učíme se s tabletem. Využití mobilních technologií ve vzdělávání,* Praha: Wolters Kluwer, a. s. (2015).

[2] McQuiggan, S., Kosturko, L., McQuiggan, J., Sabourin, J.: *A Handbook for Developers, Educators, and Learners,* John Wiley & Sons, Inc., Hoboken, New Jersey (2015).

[3] Crompton, H., Traxler, J.: *Mobile learning and mathematics: foundations, design, and case studies,* New York and London: Routledge (2015).

The Need to Return Today's Secondary Education to Merano Program

Zuzana Malacká

FHV, Žilina University in Žilina, Slovakia

This paper focuses on the status of mathematics in schools in the present-day society. The objectives of the curricular reform which has been under way since 2008 include many items which are inconsistent with what is actually going on in our schools. It seems to be necessary to take a look again at the situation from 19th century when in all more economically advanced countries the interest in mathematics was increasing. This was manifested even in its teaching. Social development and thus the development of education as well was a natural reaction to the then rapid development of science and technology. The development of mathematics has brought significant changes in its contents, methods and applications. In addition, teaching mathematics at universities progressed so much that it required much wider and solid foundations of secondary school mathematics.

Design-Based Research in Developing of Maths Apps

Mária Slavíčková

Department of algebra, geometry and didactics of mathematics, Faculty of mathematics, physics and informatics, Comenius University in Bratislava, Slovakia

Developing of mathematics applications which can be used on mathematics lessons is long-term activity. It requires cooperation of designers, programmers and researchers on didactics of mathematics. We are solving this problem in the project AiM (Apps in Maths) in which we establish local working group of all mentioned. We choose a DBR (Design-based research) for the process of preparation, implementation and testing. The reason for the choice of DBR is the fact, that it is at the same time engaged in two components, namely in development (design) of separate intercessions and in their systematic study. Development contains proposal, progression and application, while study presents observation and analysis. The conclusions acquired in the second phase of a particular iteration will serve us as basis for the first phase of a following iteration. Such an approach reflects a process of gradual emerge how the researcher does understand what he is examining and developing. Hence, the intention of DBR is to avoid the orientation only on a single experimentation, because the achievement of valuable research results is most possible in iterative cycles of design, implementation, evaluation and redesign, in the process the role of DBR is to record successes and failures of this development (Wood, T.; Berry, B., 2003).

We will demonstrate iterative cycles in Design based research by using different implemented mathematics applications.

Acknowledgment. AiM project is co-funded by EEA grants and the state budget of the Slovak Republic from the EEA Scholarship Program Slovakia.

References

[1] Wood T., Berry, B., (Eds.): *What does "design research" offer mathematics teacher education?* in Journal of Mathematics Teacher Education, 6(3) (2003), 195–199.

P300 Wave and Current Methods of Its Detection

Peter Szabó* **and Ján Gálik****

*Technical University of Košice, Faculty of Aeronautics and
**Institute of Neurobiology Slovak Academy of Sciences, Košice, Slovakia

The human brain contains over 100 billion nerve cells. They communicate with each other by means of electrical signals. An overall electrical activity of the brain cells is so great that it can be measured from the surface of the head. Evoked potentials, defined as a response to the stimulus, are special type of measuring neuronal activity. The object of our interest was the type of evoked potentials, which reflects our perception – "event related potentials" (ERP). The most frequently studied signal of the ERP potentials is P300 wave. The brain activity was recorded using the Emotiv EPOC neuroheadset, and freely available software OpenVibe. To detect P300 wave, the method "P300-speller-xDAWN" was used with signal analysis using Linear discriminant analysis algorithm. Report describes how these algorithms work.

Keywords. *Event related potentials, P300 wave, Emotiv EPOC, OpenVibe, Linear discriminant analysis*

Acknowledgements. This report was supported by the project APVV-0526-11.

Two Viewpoints on Scheepers' Conjecture

Jaroslav Šupina

Institute of Mathematics FSc, Pavol Jozef Šafárik University,
Jesenná 5, 041 54 Košice, Slovakia

In 1991, inspired by some problems of thin sets of trigonometric series, L. Bukovský et al. [1] introduced the notion of a wQN-space. Five years later, M. Scheepers [2] introduced an $\mathrm{S}_1(\Gamma,\Gamma)$-space, one of many diagonal principles studied in topology. Very early afterwards, he proved in [3, 4] that any $\mathrm{S}_1(\Gamma,\Gamma)$-space is a wQN-space and he raised in [4] the following conjecture, known as Scheepers' Conjecture: Every perfectly normal wQN-space is an $\mathrm{S}_1(\Gamma,\Gamma)$-space.

In recent years, our research was related to both, a wQN-space and an $\mathrm{S}_1(\Gamma,\Gamma)$-space. Hence we obtained several results related directly to Scheepers' Conjecture. In our talk, we focus on this conjecture and we present our own results associated to it.

Acknowledgement. Supported by the grant VVGS-2014-176 of Pavol Jozef Šafárik University in Košice.

References

[1] Bukovský L., Recław I. and Repický M., *Spaces not distinguishing pointwise and quasinormal convergence of real functions,* Topology Appl. **41** (1991), 25–40.

[2] Scheepers M., *Combinatorics of open covers I: Ramsey theory,* Topology Appl. **69** (1996), 31–62.

[3] Scheepers M., *A sequential property of* $\mathrm{C}_p(X)$ *and a covering property of Hurewicz,* Proc. Amer. Math. Soc. **125** (1997), 2789–2795.

[4] Scheepers M., *Sequential convergence in* $\mathrm{C}_p(X)$ *and a covering property,* East-West J. of Mathematics **1** (1999), 207–214.

Program 17. Konferencie košických matematikov

Programme of the 17th Conference of Košice Mathematicians

Streda – Wednesday 6. 4. 2016

12^{30} – **Obed – Lunch**

14^{00} – **Otvorenie konferencie – Conference opening**

14^{05} – Erika Fecková Škrabuľáková (ÚRaIVP FBERG TU) *Thueovské spôsoby farbenia grafov*

14^{25} – Juraj Valiska (ÚMV PF UPJŠ) *(F,H)-WORM zafarbenia rovinných grafov*

14^{45} – Mária Maceková (ÚMV PF UPJŠ) *Štruktúra rovinných grafov minimálneho stupňa 2*

15^{05} – Jana Chudá (ÚMV PF UPJŠ) *Keď žiaci chápu zadanie ináč ako jeho tvorcovia...*

15^{25} – Timea Gábová (ÚMV PF UPJŠ) *O rozdieloch medzi samohodnotením žiakov a hodnotením učiteľov vo vybraných oblastiach školskej matematiky*

15^{45} – **Občerstvenie – Coffee-break**

18^{00} – **Večera – Dinner**

Štvrtok – Thursday 7. 4. 2016

8^{30} – **Exkurzia do Košíc – Excursion to Košice**

12^{00} – **Obed – Lunch**

16^{00} – Petr Olšák (KM FE ČVUT) *Rozprávanie/tutoriál o TEXu a balíku makier OPmac*

18^{00} – **Večera – Dinner**

Piatok – Friday 8. 4. 2016

9^{00} – Stanislav Lukáč (ÚMV PF UPJŠ) *Rozvíjanie bádateľských spôsobilostí vo vyučovaní matematiky*

9^{50} – Jozef Doboš (ÚMV PF UPJŠ) *Šablóny pre prezentácie používajúce LaTeX*

10^{10} – **Občerstvenie – Coffee-break**

10^{40} – Robert Jajcay (KA FMFI UK Bratislava) *Lower bounds for the orders of cages based on counting cycles*

11^{30} – Róbert Hajduk (CCVaPP UPJŠ Košice) *40 rokov korešpondenčných matematických seminárov (nielen) na Východnom Slovensku*

12^{30} – **Obed – Lunch**

14^{00} – Zuzana Malacká (FVH ŽU Žilina) *Potreba návratu dnešného stredoškolského vzdelávania k Meranskému programu*

14^{20} – Iveta Kohanova (KAGaDM FMFI UK Bratislava) *Ako na matematike zaujať generáciu Z?*

14^{50} – Beatrix Bačová (SvF ŽU Žilina) *The effects and consequences of the content reform of education on the students of technical universities*

15^{10} – **Občerstvenie – Coffee-break**

15^{40} – Irena Jadlovská (KMTI FEI TU Košice) *From Descartes' rule of signs to the fastest algorithm for isolating polynomial roots*

16^{00} – Jaroslav Šupina (ÚMV PF UPJŠ) *Two Viewpoints on Scheepers' Conjecture*

16^{20} – Petr Olšák (KM FE ČVUT Praha) *Užití TeXové šablony CTUstyle pro studentské závěrečné práce na ČVUT v Praze*

18^{30} – **Večera a spoločenský večer – Dinner & Party**

Sobota – Saturday 9. 4. 2016

8^{30} – Matúš Kirchmayer (MATSUKO s r.o.) *How mathematics empowers game creators*

9^{10} – Mária Slavíčková (KAGaDM FMFI UK Bratislava) *Prístup „Design-based research“ pri vývoji matematických aplikácií*

9^{30} – Andrej Ferko (KI FMFI UK Bratislava) *Questionable Questions*

10^{20} – Peter Szabó (LF TU) *Súčasné metódy detekcie vlny P300*

10^{40} – **Záver konferencie – Conference closing**

10^{45} – **Občerstvenie – Coffee-break**

11^{00} – **Obed – Lunch**

Zoznam účastníkov – List of participants

Bača Martin – Katedra aplikovanej matematiky a informatiky SjF TU, Košice, SR, martin.baca@tuke.sk

Bačová Beatrix – Katedra stavebnej mechaniky a aplikovanej matematiky, SvF ŽU v Žiline, SR, beatrix.bacova@fstav.uniza.sk

Berežný Štefan – Katedra matematiky a teoretickej informatiky FEI TU, Košice, SR, stefan.berezny@tuke.sk

Borsík Ján – Matematický ústav SAV, Košice, SR, borsik@saske.sk

Buša Ján – Katedra matematiky a teoretickej informatiky FEI TU, Košice, SR, jan.busa@tuke.sk

Doboš Jozef – Ústav matematických vied PF UPJŠ, Košice, SR, jozef.dobos@upjs.sk

Draženská Emília – Katedra matematiky a teoretickej informatiky FEI TU, Košice, SR, emilia.drazenska@tuke.sk

Fecková Škrabuľáková Erika – ÚRaIVP FBERG TU, Košice, SR, erika.skrabulakova@tuke.sk

Feňovčíková Andrea – Katedra aplikovanej matematiky a informatiky SjF TU, Košice, SR, andrea.fenovcikova@tuke.sk

Ferko Andrej – Katedra informatiky, FMFI UK, Bratislava, SR, ferko@sccg.sk

Gábová Timea – Ústav matematických vied PF UPJŠ, Košice, SR, timea.gabova@student.upjs.sk

Hajduk Róbert – Ústav matematických vied PF UPJŠ, Košice, SR, robert.hajduk@upjs.sk

Chudá Jana – Ústav matematických vied PF UPJŠ, Košice, SR, jana.chuda@student.upjs.sk

Ižaríková Gabriela – Katedra aplikovanej matematiky a informatiky SjF TU, Košice, SR, gabriela.izarikova@tuke.sk

Jadlovská Irena – Katedra matematiky a teoretickej informatiky FEI TU, Košice, SR, ijadlovska@gmail.com

Jajcay Robert – Katedra algebry, FMFI UK, Bratislava, SR, robert.jajcay@fmph.uniba.sk

Kimáková Zuzana – Katedra aplikovanej matematiky a informatiky SjF TU, Košice, SR, zuzana.kimakova@tuke.sk

Kirchmayer Matúš – MATSUKO spol. s r. o., Košice, SR, matus.kirchmayer@gmail.com

Klešč Marián – Katedra matematiky a teoretickej informatiky FEI TU, Košice, SR, Marian.Klesc@tuke.sk

Kohanova Iveta – Katedra algebry, geometrie a didaktiky matematiky, FMFI UK, Bratislava, SR, kohanova@fmph.uniba.sk

Lascsáková Marcela – Katedra aplikovanej matematiky a informatiky SjF TU, Košice, SR, marcela.lascsakova@tuke.sk

Lukáč Stanislav – Ústav matematických vied PF UPJŠ, Košice, SR, stanislav.lukac@upjs.sk

Maceková Mária – Ústav matematických vied PF UPJŠ, Košice, SR, maria.macekova@student.upjs.sk

Malacká Zuzana – FVH ŽU v Žiline, SR, zuzana.malacka@fpv.uniza.sk

Myšková Helena – Katedra matematiky a teoretickej informatiky FEI TU, Košice, SR, Helena.Myskova@tuke.sk

Olekšáková Denisa – Katedra aplikovanej matematiky a informatiky SjF TU, Košice, SR, denisa.oleksakova@tuke.sk

Olšák Petr – Katedra matematiky, FE ČVUT, Praha, ČR, petr@olsak.net

Schrötter Štefan – Katedra matematiky a teoretickej informatiky FEI TU, Košice, SR, stefan.schrotter@tuke.sk

Slavíčková Mária – Katedra algebry, geometrie a didaktiky matematiky, FMFI UK, Bratislava, SR, slavickova@fmph.uniba.sk

Spišiak Ladislav – Gymnázium Šrobárova, Košice, SR, spisiakl@srobarka.sk

Szabó Peter – Katedra aerodynamiky a simulácií LF TU, Košice, SR, peter.szabo@tuke.sk

Šupina Jaroslav – Ústav matematických vied PF UPJŠ, Košice, SR, jaroslav.supina@upjs.sk

Šveda Dušan – Ústav matematických vied PF UPJŠ, Košice, SR, dusan.sveda@upjs.sk

Valiska Juraj – Ústav matematických vied PF UPJŠ, Košice, SR, juraj.valiska@student.upjs.sk

Názov: 17. Konferencia košických matematikov

Zostavovatelia: Ján Buša, Jozef Doboš
Vydavateľ: Technická univerzita v Košiciach
Rok: 2016
Vydanie: prvé
Náklad: 45 ks
Rozsah: 27 strán
Vydané v Košiciach, 2016
Elektronická sadzba programom pdfTEX
Tlač: Univerzitná knižnica TUKE, Němcovej 7, 042 00 Košice

ISBN 978-80-553-2542-2

ISBN 978-80-553-2542-2