



The first group photo at the headquarters of Regimento de Cavalaria nº6 de Braga

MATCAMPUS2010 — A COMPLETELY NEW EXPERIENCE

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I THE MEETING

If you had visited the University of Minho and the University of Santiago de Compostela last July, you would find a different environment. Forty teenagers from Portugal and Galiza, together with four high school teachers participated in the meeting MatCampus 2010 — a mathematical camp between Portugal and Spain, from the 18th to the 31st of July.

MATCAMPUS 2010 was an initiative of the International Mathematical Centre (CIM) and was jointly organized by CIM, the Faculty of Mathematics at the University of Santiago de Compostela (USC) and the Department of Mathematics and Applications at the University of Minho (UM). The main objective of this meeting was to give galician and portuguese 17 year

old students the opportunity to gain hands-on experience and to discuss mathematics. This initiative, pioneered in Europe, has developed a unique environment for cultural exchange. The institutions involved are recognized for their high quality research in mathematics, with well qualified teachers with previous experience in the out-reach activities of mathematics in different contexts. These include Math Olympiad, the project ESTALMAT to stimulate mathematical talent and the National Championship of Mathematical Games.

Several aims were proposed for this activity. These included

- to encourage positive attitudes and special capabilities of the participants in the field of mathematics;



Group photo in Aula Magna, USC

- to broaden the mathematical background of the participants on issues that are motivating and not part of the school curriculum;
- to deepen the knowledge and use of new technologies (graphing calculators, mathematics software, internet, ...) as a source of information, updating and as a learning environment;
- to consolidate and increase the stimulation of curiosity, the formulation of interesting questions, knowledge and practice of methods, techniques and work processes specific to mathematics;
- to provide a more humane vision of mathematics through reports, readings and other activities;
- to provide tools and enhance personal resources to continuous learning, self-oriented study and through teamwork.

All these purposes were achieved.

With in MATCAMPUS 2010, the organizers also wanted to establish an international collaboration that may serve as a reference for mathematical european campus for youth. The organizers hope that this event may be continued and be repeated in other European countries or regions, thereby enhancing the image of Portugal and Galicia in European landscape of mathematics education. In this sense, the activities undertaken in 2010 were recorded on the MatCampus own website.¹

The event had the scientific support of the *Real Sociedad Matemática Española* (RSME), of the *Sociedad de Estadística e Investigación Operativa* (SEIO), of the *Sociedad Española de Matemática Aplicada*

¹<http://www.matcampus2010.org>

(SEMA) and of the *Sociedade Galega para a Promoción da Estatística e a Investigación de Operacións* (SGAPEIO) and members from many different universities were involved.

2 THE ACTIVITIES

MATCAMPUS 2010 was a two week event. The first week took place in Braga and the second one in Santiago de Compostela. The main idea was to combine scientific and pedagogical activities with leisure ones.

The mathematical sessions took place in the Department of Mathematics and Applications of UM and in the Faculty of Mathematics of USC, which provide all the facilities necessary to carry out the proposed activities. In Braga, the participants stayed in the headquarters of the Regimento de Cavalaria n° 6 and had their meals in the university canteen. In Santiago de Compostela, they slept and had their meals in the university residence Monte de la Condesa, near the faculty building.

The participants were never left without supervision. Alexandre Cortés Ayaso and Rafael Fernández Casado, from Galiza and members of the Organising Committee of MatCampus, Paula Gomes and João Paulo Gonçalves, from Portugal, are four high school teachers that accompanied the forty students during the two weeks. These four teachers were fundamental for the success of MatCampus 2010.

2.1 IN BRAGA

DAY 1.—The first activity was led by the project *Atractor*, coordinated by Professor Arala Chaves, from



One moment of the mathematical Logic session

University of Porto. This activity, focused on the dvd “Symmetries” recently launched by Atractor, presented to students, in a playful and attractive way, the seventeen plane symmetry groups and seven frieze patterns. In the afternoon, the students went to Campus of Azurém, in Guimarães, which is the second campus of UM. There, they were able to observe the work developed in the area of robotics by scientists of UM, from the Departments of Industrial Electronics and of Mathematics and Applications. This trip to Guimarães finished with a visit to the town castle, the so-called birth place of Portugal.

DAY 2.—On Tuesday morning, a session on Mathematical Computation was presented by two members of the Mathematics and Applications Department of UM, Joana Torres and Ricardo Severino. In this course some computationally simple mathematical models were explored that show how you can lose the ability to predict temporal evolution. The concepts of fractal and deterministic chaos were presented. After lunch, the participants worked with the software Surfer in an activity organised by Stephan Klaus, from the Mathematisches Forschungsinstitut Oberwolfach, connected with the project Imaginary 2008 (<http://www.imaginary2008.de/>).

In the evening, the students participated in a Photo-paper at the town center, which allowed them to have a different view of Braga.

DAY 3.—The morning of day 3 was dedicated to astronomy, with a talk presented by Cacilda Moura, from Physics Department of UM, and Mathematical Logic, with a working session. In this session, coordinated by three members of the Organising Committee of MatCampus, Paula Mendes Martins, Cláudia Mendes Araújo and Suzana Mendes Gonçalves, all from UM, the participants were invited to answer some intriguing problems, using the concepts of Mathematical Logic first introduced. The afternoon was dedicated to a visit to Museu D. Diogo de Sousa and a boat ride on Rio Cávado.

DAY 4.—The participants had the opportunity to relate mathematics and music. The musical activities were streamlined by Ana Pereira do Vale (University of Minho) and Maria Helena Albuquerque (University of Coimbra). Using mathematical concepts, the students were able to compare styles of music, and conclude that the mathematical structure behind every style of music is the same. To complete the schedule in the morning, António Machiavelo, from University of Porto, gave a talk about cryptography.



One of the classrooms where the students attended sessions

The officer in charge of the headquarters where the students stayed during the first week kindly offered the participants a pleasant afternoon, showing them the facilities, along with some military exercises and allowing each student to have a ride on their magnificent horses.

DAY 5.—This was the last day at the University of Minho. The morning began with a working session on graph theory, led by Assis Azevedo, from UM, CIM and also a member of the Organising Committee. The software Grin was the tool used for the entire session. Isabel Leite, a high school teacher from Escola Secundária de Vila Verde and also a member of the Organising Committee, led the following session, based on sensors. Although some portuguese students had worked with this kind of material in their schools (the high school mathematics plan encourages the use of sensors as much as possible), this was new for the spanish students. The day ended with mathematical games. Games such as chess, hex, traffic lights, slime trail and oware kept the participants thinking throughout the afternoon. Some puzzles including Rubik cube and Rubik cube revenge were also explored.

During the first week, the students had the opportunity to visit an interactive exhibition on Recreational Mathematics, which included 15 different activities (such as squaring polygons and soma cube) to give school students the opportunity to gain hands-on experience and to discuss mathematics. Some of the students used every break during the activities in Braga to visit and re-visit the exhibition.

On the 24th, the group went to Ponte da Barca for an orienteering event, organised by the *COM – Clube de Orientação do Minho*. The day ended with a dinner in a town restaurant. And the participants said goodbye to Braga.

2.2 IN SANTIAGO DE COMPOSTELA

On the 25th of July all was ready to welcome the participants in Santiago. Victoria Otero Espinar, Dean of the Faculty of Mathematics, and Rosa Crujeiras Casais, members of the Organising Committee, were waiting for the students in the University Residence. Other members of the welcoming committee, tutors that permanently accompanied the students during their stay in Santiago, also participated: Carmela Rodríguez Alvarez, Rosalia Rodriguez Couceiro, Cibrán Santos Bouza and Jose Luis Villarino Barja. After the break and lunch all participants visited the city.

DAY 1.—The week started with a welcoming ceremony in the Aula Magna of the Faculty of Mathematics, with the participation of academic authorities, sponsors and many of the professors of the Faculty.

After an obligatory visit to the Faculty's facilities, the students went to Caixa Galicia CIEF Center to attend the Lecture given by the well-known geneticist Angel Carracedo, Director of the Institute of Legal Medicine of USC. In this talk, they were able to check the interdisciplinary nature of the sciences and the necessity of mathematical knowledge in the development of sciences. The genetic laws of Mendel introduced mathematical models based on the observation of biologic experiments. Today, genetics is a science in its own right, whose results are directly related to improvements in stochastic modeling.

To complete the topic, a session on Mathematics of genetics was presented by two members of the Department of Statistics and Operational Research of USC, Manuel Magariños and Rosa Crujeiras Casais. In this course, using genetical basis, some simple mathematical models that show population evolution were explored.



Photo Composition by Ana Rita Gomes, from Escola Secundária da Gafanha da Nazaré (Portugal)

In the afternoon, the participants visited the Centro de Supercomputación de Galicia. The CESGA is the center for high-performance computing, communications and advanced services used by the Scientific Community of Galicia including the University System of Galicia and the Spanish National Research Council (CSIC). The students were able to simulate the previously explained mathematical genetic models by using the facilities of the Cesga's high performance computer, Finisterrae.

A good way to finish a hard day was the visit to the Astronomical Observatory Ramón María Aller of the USC. In this visit, participants were immersed in the science of astronomy. They dreamed once more with the planets, comets, stars, galaxies, etc ... helped by the interesting presentation and nocturnal observations of Professor José A. Docobo Durántez, Director of the Observatory, and Professors Josefina Ling Ling and Pedro Pablo Campo Diaz.

DAY 2.—To show that mathematics are essential to an understanding of the world around us, the day was devoted to mathematical modeling of real problems. In the workshop Numerical simulation of industrial problems: an acoustic structural problem was presented by Andrés Prieto Aneiros, from Faculty of Mathematics of the USC, who showed how numerical simulation tools can be applied to the resolution of industrial and business processes.

The thematic day addressed to mathematical simulation techniques ended with a visit to the company Castrosúa, which collaborates with a researchers's team of the Faculty of Mathematics.

DAY 3.—Wednesday morning was dedicated to visiting Science museums in the city of A Coruña. The students were introduced to scientific novelties in the *Casa das Ciencias*, and in an interactive journey through the human body in DOMUS.

Taking advantage of the proximity of the sea, the participants enjoyed a pleasant afternoon on the beach.

DAY 4.—In the session dedicated to calendars, the mathematician José María Barja, Rector of the University of A Coruña, showed how the history of calendars is strongly linked to the history of mathematics. In this activity, various ways of measuring time throughout history were reviewed and exercises on calculations related to calendars were carried out.

To complete the schedule in the morning, the Delegate to Galicia of the Olympic Committee of the Real Sociedad Matemática Española, Felipe Gago Couso, member of the Faculty of Mathematics of the USC, gave a talk about working skills for problem solving: strategies, techniques for simplification, generalization and analysis of problem formulation.

In the afternoon, there was a mathematical tour of Santiago de Compostela, coordinated by a member of the Organising Committee of MatCampus, Pilar García Agra.

What is a mathematical tour? Do you need to know a lot of maths to follow a route through the streets and squares of Santiago de Compostela? No, in this walk, participants had the opportunity to discover the elements and mathematical properties where least expected, in addition to the many attractions of the city. They realized the beauty that can be generated with appropriate use of shapes and geometric properties, and the students were able to train their eyes to capture the mathematical relationships that are sometimes hidden in the most unexpected objects. This was shown subsequently in photographs that the participants took for a Mathematical Photograph Competition, organised by three members of the Organising Committee of MatCampus, Elena Vazquez Abal, Rosa Crujeiras Casais and Victoria Otero Espinar.

DAY 5.—The whole morning was occupied by a working session on Origami, led by Teresa Otero Suárez and Miguel A. Vidal Martín, high school teachers. In this activity, origami was used as a didactic resource in mathematics. The students used modular origami to allow a physical representation and to test properties of polyhedra .

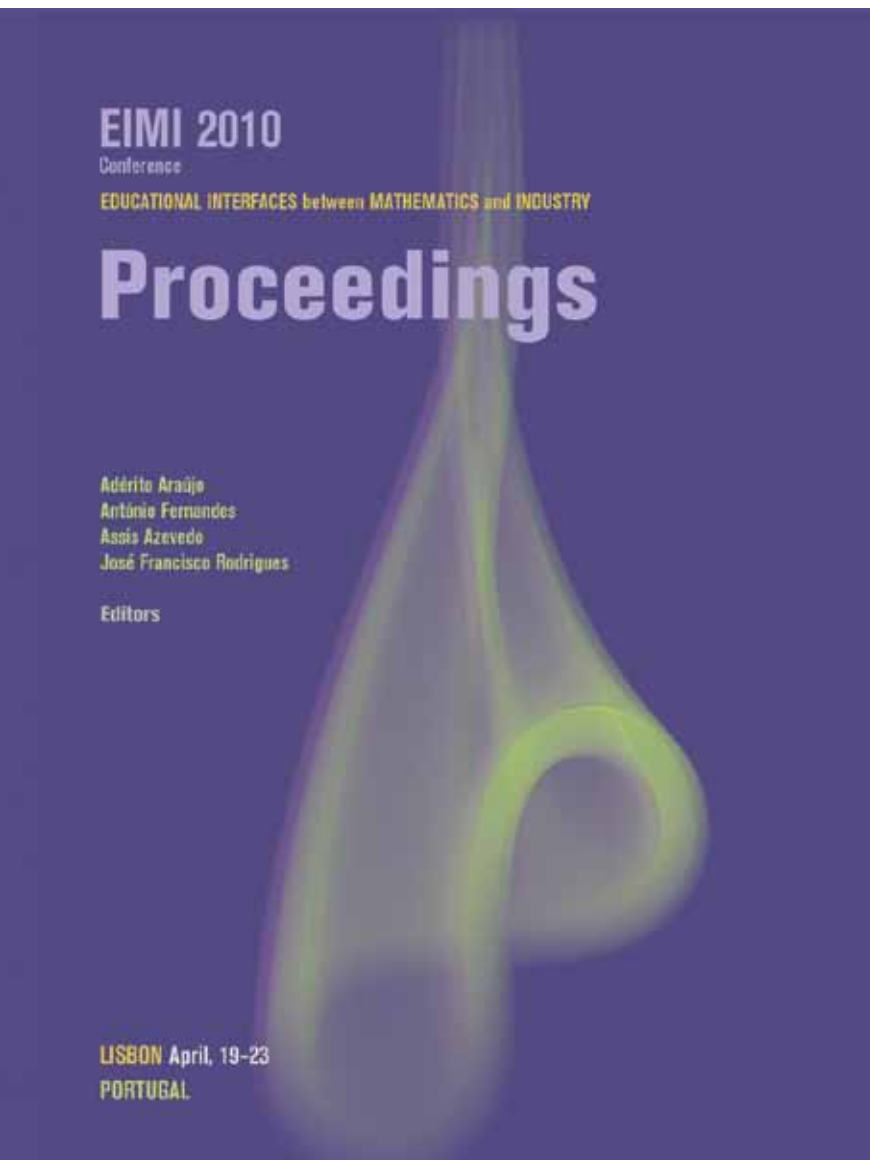
The mathematical camp MatCampus 2010 ended on Friday with a closing ceremony that took place in the Aula Magna of the Faculty of Mathematics. The program of activities of these last two weeks ended with a play, “Inúmeros Números”, by César Goldi and Vicente de Souza.

3 WAS IT WORTHWHILE?

When an event like MATCAMPUS 2010 comes to an end, the obvious question arises: was it Worthwhile? In the case of MATCAMPUS 2010, the answer is also obvious: Yes, it was.

When, by suggestion of José Francisco Rodrigues, the Organising Committee (Paula Mendes Martins,

Assis Azevedo, Cláudia Mendes Araújo, Suzana Mendes Gonçalves, Isabel Leite, María Victoria Otero Espinar, María Elena Vázquez Abal, Rosa María Crujeiras Casais, Pila García Agra, Rafael Fernández Casado and Alexandre Cortés Ayaso) began to prepare MATCAMPUS 2010, the organisers could not imagine how successful this mathematical camp was going to be. At the end of the two weeks, the forty participants were unanimous in affirming that they were very lucky to be chosen to take part of MATCAMPUS 2010. Everyone asked for MatCampus new edition in 2011 because they were willing to repeat the experience. This was a completely new experience that should be repeated for many years and by as many universities as possible.



EIMI 2010 Proceedings

In partnership with COMAP, on behalf of CIM, A. Araújo, A. Fernandes, A. Azevedo and J. F. Rodrigues have edited the EIMI PROCEEDINGS of the international conference on “Educational Interfaces between Mathematics and Industry” of the ICMI/ICIAM international study, which are available on line at the CIM website http://www.cim.pt/files/proceedings_eimi_2010.pdf and were available for the associates in book form at the CIM annual general assembly in May.