A Competition in Connection with "Mathematics of Planet Earth 2013": Modules for a Virtual Exhibition

Ehrhard Behrends (Berlin), Andreas Matt (Oberwolfach) and José Francisco Rodrigues (Lisbon)

Logo of the Mathematics of Planet Earth Initiative

During the 2010 International Congress of Mathematicians, held in Hyderabad, India, at the meeting of delegates of the International Mathematical Sciences Institutes, Christiane Rousseau (Montreal) presented an invitation to institutes and societies in mathematical sciences around the world: *Mathematics of the Planet Earth 2013* (see www.mpe2013.org). This initiative, first launched in the USA and Canada, now has many partners in Europe, including the European Mathematical Society, and around the world, obtaining the endorsement of the International Mathematical Union, the International Council of Applied and Industrial Mathematics and the International Commission of Mathematical Instruction.

MPE2013 is now a worldwide project that consists of holding a year of activities in 2013 under the theme of the role mathematics plays in issues concerning the Planet Earth. The idea is to present scientific events, research programmes and activities for the public, media and schools. As an opportunity for raising public awareness in mathematics, several activities are expected and are being organised. They may include public lectures, panel discussions, media or television programmes, exhibitions, articles in newspapers and magazines, posters, websites, school activities and projects, outreach to teachers, etc.

A Global Exhibition on Mathematics of Planet Earth was proposed by the CIM (Centro Internacional de Matemática) director at the occasion of the ERCOM meeting, held at the Mathematical Institute of Oberwolfach in April 2011. The concept is based on an Open Source Exhibition with modules that could be reproduced and utilised by many users around the world, from science centres and museums to schools. The realisation should not be centralised. It will instead be split among many partners around the world, possibly with collaborative networks of participants. The exhibition will have a virtual part as well as several material parts. Copies of the material parts could be recreated or travel around the world and the virtual modules could be available on the basis of Creative Commons licences. These licences allow, for example, others to remix, tweak and build upon the licensed work non-commercially, as long as they credit the authors and license their new creations under identical terms. In this way the modules can be distributed and used by many partners.

If possible, there will be a global opening coordinated at the same day in many countries in order to amplify the visibility of the mathematics.

The MPE2013 Museum and Exhibits Committee has now launched a competition of virtual modules that, in particular, aims to fulfil this purpose.

The competition of modules for a virtual exhibition

With this note the readers of the Newsletter of the EMS are invited to participate in the competition in connection with MPE2013. It concerns a new type of exhibition.

The competition will be open from January 2012 to 15 September 2012. The competition will be coordinated by the MPE2013 Museum and Exhibits Committee. The prize winners will be selected by an international jury nominated by MPE2013 and will be announced in October 2012. The judges' decision will be final. The first, second and third prize winners will receive, respectively, prizes of US$5,000, US$3,000 and US$2,000. The winning modules will occupy a prominent place on the website of the exhibition. Moreover, it is planned to show the modules of the overall winners in exhibitions and museums. Important museums in North America and in Europe have already agreed to prepare installations and organise exhibitions in 2013.

For further information, visit the website of the competition: http://www.mpe2013.org/competition.

The web infrastructure for the competition is provided by IMAGINARY, the open source platform for interactive math communication by the Mathematisches Forschungsinstitut Oberwolfach.

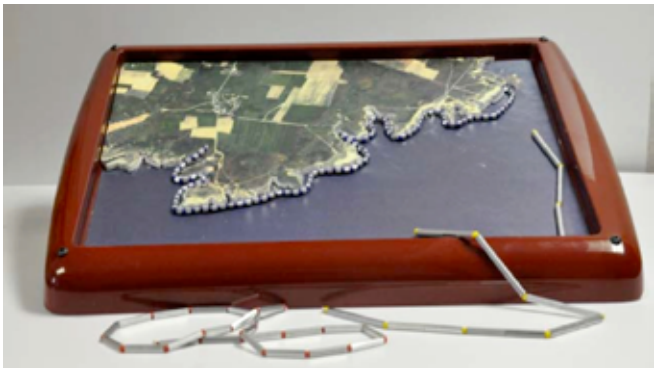
Examples of such modules

To stimulate imagination on the many domains where mathematics plays a crucial role in planetary issues the following (non exhaustive) four themes are proposed:

- *A planet to discover*: oceans, meteorology and climate, mantle processes, natural resources, celestial mechanics.
- *A planet supporting life*: ecology, biodiversity, evolution.
- *A planet organised by humans*: political, economic, social and financial systems, organisation of transport and communications networks, management of resources, energy.
- *A planet at risk*: climate change, sustainable development, epidemics, invasive species, natural disasters, risk analysis.

The typical modules submitted to this competition can be an idea for the construction of a physical exhibit, an interactive programme, a picture gallery with explanations or a film.

A physical module could be, for example, Fractal Coasts by Michel Darche and Mireille Chaleyat-Maurel, a polyester board with a coastline profile and several surveyor chains, an idea that has been realised at the international UNESCO supported exhibition EXPERIENCING MATHEMATICS (see http://www.mathex.org/MathExpo/ReadTheNature).



The "Fractal Coasts" module

Rocky coasts have a fractal character, unlike sandy coasts. To estimate the length of a coast, we can measure the length of an approximation of its contour with line segments of a given length: on the model, these segments are links of a chain. For a sandy coast, the length is approximately constant, when the segments are sufficiently short. But, for a rocky indented coast, the shorter the segments, the longer the length! In the limit the length is infinite. Users can test these properties by trying to measure the coasts using the different chains.

As another example one can find a five minute film at the homepage on periodic timetable optimisation of the Berlin subway by Rolf Möhring, Christian Liebchen and Sebastian Stiller.

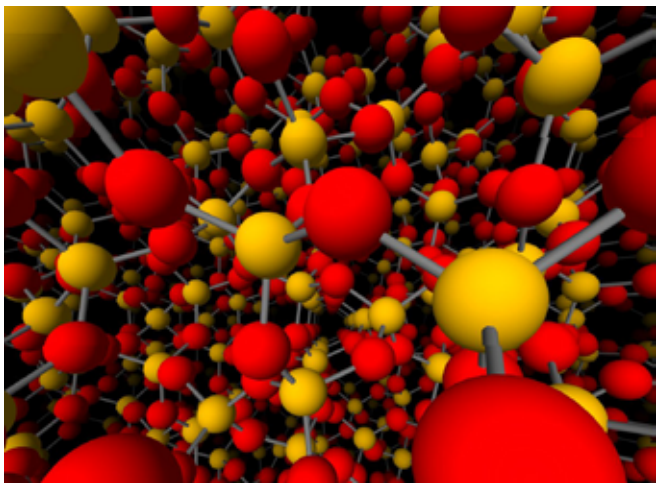
The Berlin Underground features nine lines that meet in 19 transfer stations. How can a periodic timetable be computed that minimises the total waiting time of all the passengers in this network, while respecting all safety matters? This is a highly complex task that has traditionally been handled manually by splitting it into subtasks.

The 2005 timetable for this network was computed by Matheon at the Institute of Mathematics at TU Berlin. The key was state-of-the-art combinatorial optimisation

Time table optimization

techniques. The public transport of Berlin is modelled as a graph with vertices at the stations, edges between them and constraints of different types. The optimal solution for its functioning (minimising the waiting time at stations and the number of trains required) is hidden somewhere in the set of all possible solutions respecting the constraints. But this set is much too large to be explored as a whole, even with the most powerful computers. Clever mathematical techniques produce powerful algorithms allowing the elimination of large portions of this set and concentration of the search into smaller subregions where the optimum lies.

The interactive programme Crystal Flight by Jeff Weeks serves as another example, this time for a virtual module to be used with a touch screen at an interactive station at an exhibition or museum. You can fly through a quartz, fluorite or diamond crystal and observe the mathematical structures of the crystal lattice by controlling a miniature spaceship. Using the speed control on the lower right side you can change the velocity of your spaceship.



Crystal Flight

Join this competition!

We invite you to participate in this competition and submit modules or ideas for modules to the competition. They should include instructions to realise the material module (physical module), installation instructions including technical requirements (interactive exhibit) and some accompanying scientific explanations for the public.

Everybody can be part of the competition: individuals or groups of individuals, institutions, schools or non-profit organisations. Contributions developed by profit organisations can be shared with us to be included in the open source exhibition but will not participate in the competition.

Some ideas of possible modules for the competition can be found in the document "31 ideas of modules for MPE2013" by Christiane Rousseau on the competition website. The ideas range from modules related to weather prevision, global positioning systems, cartography and population models to the management of resources, the economy of solidarity, percolation models and risk management tools.

Moreover, we would appreciate your help in making this competition known among your colleagues or anybody interested. Please spread the word! Together we can create a joint global and open exhibition to be reproduced in many countries. Let's celebrate mathematics and its many connections to our planet Earth.

References:

www.mpe2013.org/competition
www.mpe2013.org

ICIAM 2011

Some recollections from Chris Budd

If it wasn't enough to host the Winter Olympics in 2010, Vancouver in 2011 saw the influx of nearly 3000 mathematicians from over 70 countries to attend the 7th International Congress on Industrial and Applied Mathematics (ICIAM 2011). A splendid new conference centre

The conference centre at night, showing the grassy roof on top and the book exhibition within.

(originally built as the press centre for the Olympics) served as the perfect venue for displaying the power and breadth of the applications of mathematics. Topics as diverse as geometry, mechanics, the modelling of crowds, mathematical studies of cancer and oil spills, wavelet analysis, public health, epidemics, the economic crisis and climate change formed a rich diet of mathematics showing both the breadth and depth of its many applications. This filled over 500 mini-symposia, 700 lectures and 300 posters, which showed not only how mathematics can be applied but how studying applications leads to many new mathematical ideas and tools, as well as rapid developments in computational techniques. All of this demonstrated the twin truths that good mathematics has almost limitless applications and that to study these applications well requires the highest level of mathematical sophistication (with nearly every area of 'pure mathematics' featuring at some point in the meeting).

Nothing could illustrate this better then the life and work of Professor Jerry Marsden, whose fusion of dynamics with geometry and mechanics has led to profound advances in all of these areas. Jerry was co-chair of the Scientific Programme Committee for ICIAM 2011 and tragically died of cancer in September 2010. A very well conducted memorial lecture and reception in his honour (generously supported by Springer publishing), together with a series of excellent mini-symposia based on his work, formed a fitting centrepiece to ICIAM 2011.

The orca sculpture outside the conference centre.

Other highlights of the meeting were the opening ceremony, which saw some extraordinary dancing by a First Nation group, and the prizes and associated lectures. Those honoured for their work in mathematics and its applications included: Emmanuel Candes, Alexandre Chorin, Vladimir Rokhlin, James Sethian, Edward Lungu, David Keyes, Gunther Uhlmann, Ingrid Daubechies, Susanne Brenner, Beatrice Pelloni, Bjorn Engquist, Adam Oberman, Ian Frigaard and Michael Ward.

The meeting was also held in parallel with the Women in Mathematics Meeting. This organisation celebrated its 40^{th} anniversary with an excellent series of sessions including (in a particular highlight for me) a panel discussion by senior female academics on how to run a department. Excellent advice was given throughout!

The beautiful location, on the Vancouver waterfront and with fantastic views of the British Columbian coastal mountains, acted as both an inspiration for mathematical creativity and an excellent excuse to take time out from the lectures for animated networking and discussions (some of which took place on the hike up Grouse Mountain). Indeed, with so many delegates there is always the danger of overcrowding and being swamped by the sheer scale of the meeting. Often this has put me off attending very large meetings in the past but I was very pleased that this did not happen in Vancouver, a tribute both to the excellent conference centre (which simply seemed to absorb the delegates) and also the excellent organisation of the meeting. Students, established academics and industrialists all had the chance to meet as equals