

European Study Groups with Industry

Mathematics Workshops with a Difference

Mathematical study groups have evolved organically since their inception in Oxford in 1968. They retain the basic format in which academic mathematical scientists nucleate into teams to model and analyse problems which are of interest to industrial companies. Many such events are now held yearly in Europe (under the umbrella of the European Consortium for Mathematics in Industry) and around the world.

The 49th European Study Group with Industry will return to the study group's spiritual home at the University of Oxford from

Monday 29th March – Friday 2nd April 2004.

Benefits for Industry

Companies are invited to propose problems to be addressed at the study group. The primary benefits that accrue from the workshop are

- Exposure to a network of international experts in mathematical modelling, committed to the solution of industrial problems.
- Fresh looks at difficult problems that may give innovative solutions or pump-prime new problem areas.
- Professional quality report.
- Opportunities for follow-up research.

The cost for proposing a problem will be waived for first-time small and medium sized enterprises.

Format

• Monday

Problems (usually 6-9) are presented by researchers working in industry. This is followed by university researchers (usually about 60) forming brainstorming groups for each problem.

• Tuesday – Thursday

Groups work on each problem. Mathematical models are formulated, analytical and computational techniques applied and recommendations formulated.

• Friday morning

Problem-solving teams make presentations of their models and results to all participants.

• Aftermath

Each team prepares a short written report of their progress, with special emphasis on end-user applications.

Special Events

1. Dr John Ockendon FRS (Oxford) will give an overview of industrial mathematics nationally and internationally.
2. Professor Colin Please (Southampton) will present “previous study group successes”.
3. There will be a post-prandial discussion on Wednesday 31 March on “Ethical issues in applications of mathematics”. This discussion was stimulated by the possibility of problems coming from the tobacco industry.

Case studies from previous study groups

1. Sequence spinning lines in textile production (Acordis)

The Acordis acrylic fibres plant in Grimsby operates thirteen production lines, extruding four basic polymer types that are dyed to make coloured fibres. A skilled employee organises production schedules to minimise the wastage when the fibre dye colour is changed.

The Study Group was asked to design a software tool to assist production team leaders to rearrange the production schedule optimally, which must often occur out of hours when the scheduling expert is unavailable.

Results

- Models were developed for colour distances, and dye concentration changes in the production line, giving quantitative estimates of the time taken to change colours (such as black to pink taking longer than pink to red).
- The search for optimal scheduling of a week's jobs was shown to be related to the Travelling Salesman Problem, and an appropriate solution algorithm was developed and implemented in software.
- This algorithm was tested on real Acordis data, and produced within seconds similar sequences to those produced by the expert human scheduler.
- Recommendations were also made as to how the new algorithm could be modified to incorporate constraints on delivery dates.

2. Incubation of Penguin Eggs (Bristol Zoo)

Successful incubation of the eggs of rare birds is important for captive breeding programmes. Bristol Zoo participates in such a programme for the African Penguin. In the wild, birds turn their eggs occasionally during incubation. The Study Group was asked to model this mathematically in order to understand the effects of turning, and thus suggest how often eggs should be turned during artificial incubation.

Results

- By estimating the values of important parameters in the egg, it was shown that the main benefit of turning is likely to be improved access of the embryo to nutrients, a point that had not emerged in previous studies.
- The motion of the yolk and embryo was analysed as an impulsive rotation followed by a viscous equilibration. This brings out how the embryo's access to nutrients depends on the egg and yolk diameters, the density differences between embryo, yolk, and albumen, the albumen viscosity, and the turning interval.

For past examples of reports, see
http://www.smithinst.ac.uk/projects/study_groups

Contact Points

[http://www.maths.ox.ac.uk/ociam/
Study-Groups/ESGI49/](http://www.maths.ox.ac.uk/ociam/Study-Groups/ESGI49/)

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**49th EUROPEAN STUDY GROUP
WITH INDUSTRY**

UNIVERSITY OF OXFORD

29th MARCH – 2nd APRIL 2004