

# INédt

The Newsletter of the French National Institute for Research in Computer Science and Control

## Clouds at the crossroads of atmospheric phenomena

*Air pollution, weather and climate forecasts share a common feature: they are all influenced by the cloud cover. Even though clouds are elusive and hard to model, several satellite image processing methods offer us a different view of the sky.*

The clouds perturb the trajectory of sunlight in the atmosphere and that of the infrared radiation emitted by the Earth in return. In the first case, they reflect and diffract visible light. In doing so, they modify solar radiation at ground level and influence the speed of the photochemical reactions that are responsible, for example, for the formation of ozone from exhaust gas components. In the second case, the clouds absorb the infrared rays, just like greenhouse effect gases, and are thus playing an important role in the radiative balance of the Earth. Modeling this balance correctly is one of the major issues in the global warming scenarios that are being currently discussed.

The impact of clouds on such atmospheric phenomena is however

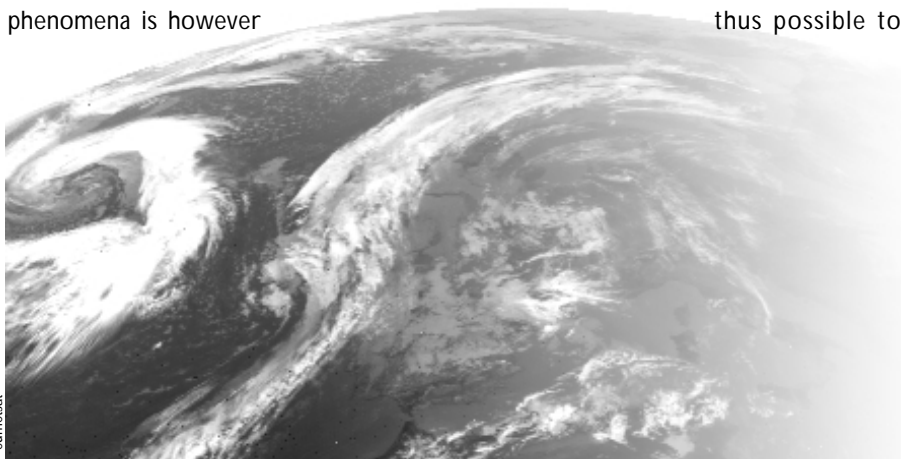
hard to model. Clouds are of very diverse sizes and shapes. Moreover, they are constantly moving and form staggered patterns. Usual satellite image processing yields a cloud cover percentage based on temperature measurements, by subtracting the reemitted energy from the energy coming from the sun. Such an estimate is not sufficient. The originality of the research carried out by project Air (INRIA) is to complement such physical measurements by using methods stemming from computer vision. This work is in the framework of the Decair European program coordinated by Ercim. The image is decomposed into objects—the ground and various types of clouds—by gathering together points that present the same characteristics in terms of position, movement and temperature. It is thus possible to

recognize the different cloud types, to forecast their position and infer their trajectory. The data supplied by the Meteosat 5 satellite produces one image per half-hour with a resolution of 2.5 kilometers. It is already used by the European ECMWF and Météofrance Arpège meteorological models.

An extension of this research, carried out in collaboration with Bruno Sportisse of the Air team in the Cereve laboratory of the Ponts et Chaussées, consists in directly evaluating solar radiation at ground level to predict pollution peaks. This considerably more precise approach involves the modeling of the radiative transfer describing the scattering and absorption of light by the clouds. This model will make it possible to deduce the incoming radiation based on satellite measurements. For now it remains limited to visible light, but can be extended to other wavelengths, for instance the infrared light involved in the greenhouse effect. However the major objective of researchers is to use the model to define the most relevant satellite measurements to estimate pollution levels. ■

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A thermal infrared image taken by the Meteosat 5 satellite. The clouds are shown in white.

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### ►Specialty: planning and scheduling

Enginest Software was founded last May within the incubator of Loria and INRIA Lorraine. The new technology company gathers skills in computer science, mathematics and industrial automation that come partly from INRIA. The company is developing and marketing planning and scheduling tools for production, transportation and logistics management among others. Part of these products, in particular in transportation planning, stems from research carried out within project Prothéo. Enginest innovative edge resides in its NCL technology (Natural Constraint Language), which is a combination of natural mathematical language and constraint programming techniques. This technology is at the source of a new industrial tool called POEM (Programming in Ordinary and Expressive Models) developed by the company. Enginest has already signed a contract to develop a system for the distribution of natural gas canisters with Gaz Est Distribution, a subsidiary of the Elf Antargaz group. This system makes for a significant improvement in efficiency. Another application envisioned by the company is the development of computation engines for human resource management in companies working on intelligent systems for enterprise resource planning (ERP). ■

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### ►A leap forward in automatized object design

Athys is a company founded in June 2000, the latest to come out of the INRIA Technology Transfer incubator. The company founder, Philippe Audfray, comes from Delmia, a subsidiary of Dassault Systèmes specializing in factory design software. He was joined by Roger Pissard-Gibollet, former head of robotic resources at INRIA Rhône Alpes and currently on leave, to develop an automatic system design software. The latter makes use of the Esterel studio technology devised by Esterel Technologies, another INRIA startup. The software was integrated into a Delmia software for 3D design of a robotic block. The whole set is called CellControl. It can be used to design the automatic functions of a system at the same time as the system itself. Prior knowledge of the functioning of the various parts of the machine is allowed, in particular the production rates, which yields a noticeable time saving. CellControl will be distributed worldwide by Delmia, starting next June. The first target is the automotive sector, but Athys is hoping to promote this technology through out the whole manufacturing sector. ■

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### ►Entering the era of multilingualism

Lucid-IT was founded on November 20, 2000, by a young doctoral candidate with an INRIA fellowship to create a company, and a researcher from the Henri Poincaré Nancy 1 University. The company offers both basic products for Open Source XML as well as more specific tools for the creation and management of the multilingual contents of electronic documents and software. These tools and accompanying customized services will allow companies and institutions to meet the new challenges posed by the internationalization of the market more efficiently, concerning in particular the adaptation of their products to users speaking different languages. To achieve this aim, Lucid-IT is leveraging the Dhydro technology (a distributed management software for multilingual terminology databases designed by project Langue et Dialogue), multilingual linguistic engineering tools (translation memory, alignment of texts in several languages...) and XML skills. ■

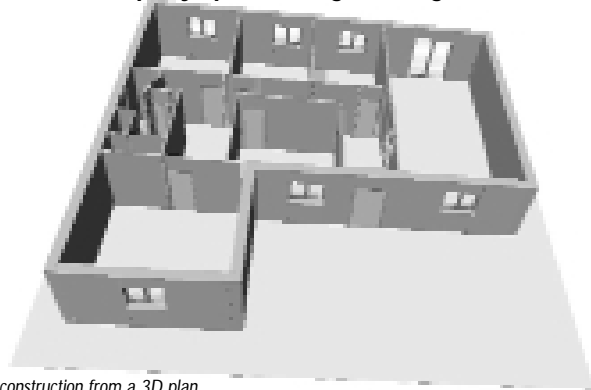
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# A tiler's puzzle

An interview with **Didier Dumont**, general manager of FS2I, a company specializing in tiling trade software



© Isa project, Loria / INRIA Lorraine

3D reconstruction from a 3D plan

**Knowing how many elements are a priori needed to complete a tiling and how to minimize offcuts are practical problems that raise complex questions, from simple algorithmics to automatic plan recognition.**

**INédit** : What is gridding ?

D. D. : It is pretty much the same thing as what mathematicians call tiling. The question is to compute how many identical forms, such as tiles, are necessary to cover a given surface. Every building company does gridding planning to predict the supplies necessary to complete a construction and to estimate the costs. Drawing such a plan without a computer is extremely tedious. FS2I offers its clients software that do it automatically, thus saving much time not only in terms of drawing the plans, but also estimating the precise cost of the construction and optimizing of the offcuts.

**INédit** : Why call on INRIA ?

D. D. : Up to quite recently, FS2I software was only able to achieve simple pavings made of squares or rectangles. Planning pavings that create patterns by assembling elements of different shapes and sizes, raises geometry problems that our company was not able to solve. The installation of heating plates inside suspended ceilings (modular radiative ceilings) entails a further difficulty, the optimal distribution of heating modules under the paving, in order to minimize the cabling length.

In addition to the questions of geometry there is the problem of the gridding drawing itself. There are plan vectorization software packages available, but they require a lot of clean-up work

and the plans obtained are too simplified. We are thus looking into improving the precision of the recognition of the measurement of the surface to be tiled and limiting the retouch work. This poses highly specialized problems in the automatic analysis of graphics and plan vectorization. This is a longer term exploratory work on which we are collaborating with the Isa project (Loria/INRIA Lorraine). Project Isa is developing applications in computer vision and graphics. These researchers are studying methods to convert images into graphics that are a lot more precise, in particular concerning the positioning of junctions between vectors.

**INédit** : How does this collaboration work ?

D. D. : We have signed a three-year partnership agreement with the Isa team in 1999. The agreement includes questions directly in connection with gridding. The latter were the object of a technology transfer through specific studies carried out in 1999 by the Isa and Macsi projects, that are being continued in the form of consulting on the algorithmics of gridding. The work on graphics recognition is the subject of a Cifre doctoral thesis and should eventually result in a high performance solution to vectorize plans and obtain reliable measurements. ■

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# Pricing out demand

To manage the traffic on a telecommunication or road network, it is important to take into account user reactions to the service offered. This question boils down to a sequence of nested, particularly hard to solve, optimization problems that integrate a complex model of demand.



Will an express bus shuttle service taking highway A14 from Orgeval to La Défense attract any users? What should the fares be, which bus sizes and frequencies are needed to achieve this goal? These are the kind of questions that the work initiated by Laura Wynter at the Prism laboratory of the University of Versailles is intending to answer. She is currently continuing her research at INRIA within the project Metalau. The research concerns the development of tools to solve such problems making use of, in particular, the Scilab scientific computing environment.

Make no mistake: behind the practical aspects of the question lurk extremely complex modeling problems. To give an example, consider an administrator from a transportation company. He or she wants to determine the parameters that will maximize profits. The solution however must take into account user demand since the latter react to the criteria fixed by the administrator by modifying their choices. This so-called hierarchical relation between a service provider and users is expressed mathematically by nested optimization problems. The second level, which consists in describing the path taken by the

user in terms of the characteristics offered by the network, is especially delicate. The problem can be summed up by a variational inequality in often more than 10,000 variables! Additionally, the definition of an optimal solution to the hierarchical system is a challenge because it combines nondifferentiability and nonconvexity of the functions and feasible regions.

Demand modeling brings additional complexity. Indeed, the basic assumption is that users always make the best choice, which is far from being the case. Economists have been working hard on this question for about twenty years and have refined demand models by introducing a random factor into user responses. It is thus necessary to integrate models from such work, taking into account the numerous parameters that describe individual behavior and the nature of the supply (how attractive is the route, travel time, car ownership, salary and so on). In practice, certain databases like the National transportation global survey, give statistics on the transportation habits of families—transportation modes, routes, frequency, etc—that can be used to calibrate the models.

For the time being, Laura Wynter and her coworkers are developing such a model in partnership with the CGEA Connex in the framework of the National Program for Research and Innovation in Ground Transportation (PREDIT\*). This approach is also applied to other fields such as the management of Internet congestion. The researchers are already working in collaboration with France Télécom R&D on the design of optimal price setting methods. ■

\*A program at the initiative of the Ministries in charge of Research, Transportation, the Environment and Industry, as well as the Ademe and the Anvar.

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#### ► APPOINTMENTS

The year 2001 is bringing about a few changes: **Bernard Espiau** is replacing Jean-Pierre Verjus at the head of INRIA Rhône-Alpes and **Hélène Kirchner** is replacing Michel Cosnard at INRIA Lorraine and LORIA. **Jean-Pierre Verjus** is now the head of a newly founded Department of Scientific Information and Communication, which replaces the former communication division and a Department of International Relations still headed by **Stéphane Grumbach** replaces the former international relations division. ■

#### ► ALL-OUT RECRUITMENT

INRIA is offering numerous positions of researchers, engineers, technicians, administrative staff and so on in 2001. Fixed-term contracts for academics and other civil servants, as well as specialists from industry and foreign academics are also available. Recently graduated engineers are not left out, see page 4. All these positions are open to French and foreign candidates. ■

<http://www.inria.fr>

#### ► FRANCO-MOROCCAN COOPERATION

The first operational thematic network "networks and telecommunications" of the four networks provided for by the Franco-Moroccan research program in computer science was set up at the beginning of 2001 for a duration of three years. This initiative is intended to strengthen a traditional cooperation with Morocco in this field. It is supported by the French Embassy in Morocco and involves numerous French (INRIA, CNRS, ENS Cachan, University of Paris 6, INSA Lyon) and Moroccan (University Mohammed V-ENSIAS, Engineering School-EMI, Moroccan Ministry for Higher Education, Executive Training and Scientific Research) partners. This network is meant to make management tools for cooperative distributed applications primarily for distance learning. It is still open today to the participation of industrial partners. Three other networks are still in preparation and should include topics concerning software engineering and life sciences, among others. The call for proposals will be available this summer. ■

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## Sixty positions for associate engineers open in 2001

**INRIA has been proposing engineering positions in teams from the Institute for a maximum duration of two years since last year. These positions are open to all new French or foreign graduates.**

In 2000, many young engineers applied to the positions offered by INRIA. Those who were selected have been integrated into a research team beginning last September. They find it a rewarding experience, from several viewpoints. Cynthia Alland, holder of a DEA in biology and enhanced by one year of training in bioinformatics, is working on a technical platform dedicated to the analysis of gene sequences by biologists. "This is an opportunity for me to improve my knowledge in bioinformatics and see how the work goes in practice between biologists and computer scientists." For Céline Hernandez, a bio-mathematician with a DESS in computer science applied to biology, this experience was instrumental in convincing her that there were interesting things to do in computer science in terms of biology. She appreciates being immersed in leading edge research, "I have a global view of what is going on today in the field. Moreover, I have contacts with researchers, but also with businesses, which is still rare at the university." Hassen Kacem is a young Tunisian graduate hired to work on the verification of timed automata. He stresses the interest of "coupling a professional experience with a rather basic kind of work and the possibility of teaching."

Julien Guyard has a different history. After a solid training in computer science and electronics, he worked two years in service companies. He applied at INRIA with the idea of thinking his professional career over, "I'm acquiring skills here and top notch experience in a prevalent field, multimedia documents. This is a professional experience that will be valuable to my future employers." ■

For all information: <http://www.inria.fr>

## Books

### FOUNDATIONS OF DATABASES

**Serge Abiteboul, Victor Vianu and Rick Hull**

Vuibert informatique, 2000, 736 pages

Database theory is a relatively new discipline in computer science. At the beginning of the 1960s, a first step toward the abstraction of filesystems led to relational databases and its associated theory, using logic as a catalyst. This now mature theory is exposed in this work through classical material as well as advanced themes. The book should be a useful resource for all computer scientists, mathematicians, researchers or students. Numerous examples and exercises are included in each chapter. ■

*Serge Abiteboul is a researcher in project Verso (INRIA Rocquencourt).*

*This issue of Inédit contains a recruitment notice for INRIA.*

### PERTURBATION ANALYSIS OF OPTIMIZATION PROBLEMS

**J. F. Bonnans and A. Shapiro**

Springer-Verlag, May 2000, 601 pages

This book is a presentation of general results intended to discuss local optimality, the computation of the expansion of the value function and approximate solutions to optimization problems. Application to various fields, from physics to economics, are also given. The book provides an opportunity of popularizing these techniques among researchers involved in other sciences, including users of optimization in a broad sense, in mechanics, physics, statistics, finance and economics. ■

*J. F. Bonnans is a researcher in project Moccoa (INRIA Rocquencourt).*

## INRIA ORGANIZES OR CO-ORGANIZES

### ► "COMPUTER ARITHMETIC" SCHOOL

29th Spring School of Theoretical Computer Science

March 26-30, 2001

Prapoutel-Les-Sept-Laux, France

<http://www.inria.fr/actualites/colloques/ado/>

### ► APMS'2001

Second International Conference on Atmospheric Pollution Modeling and Simulation

April 9-13, 2001

Champs-sur-Marne, France

<http://www.inria.fr/apms01>

### ► JPLC'2001

Tenth French-Speaking Meeting on Programming in Logic and Constraint Programming

April 24-27, 2001

Cité des Sciences, Paris, France (1<sup>st</sup> call for communications)

<http://contraintes.inria.fr/jplc2001/>

### ► OCM'2001

Objects, Components, Models

May 10, 2001

Rennes, France

<http://www.ocm-ouest.org>

## INRIA SPONSORS

### ► IEEE WORKSHOP ON VARIATIONAL AND LEVEL SET METHOD IN COMPUTER VISION

July 13, 2001

Vancouver, Canada

<http://www.scr.siemens.com/vism01/>

All the tutorials and colloquia are on the Web at: <http://www.inria.fr/actualites/colloques/index.fr.html>

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