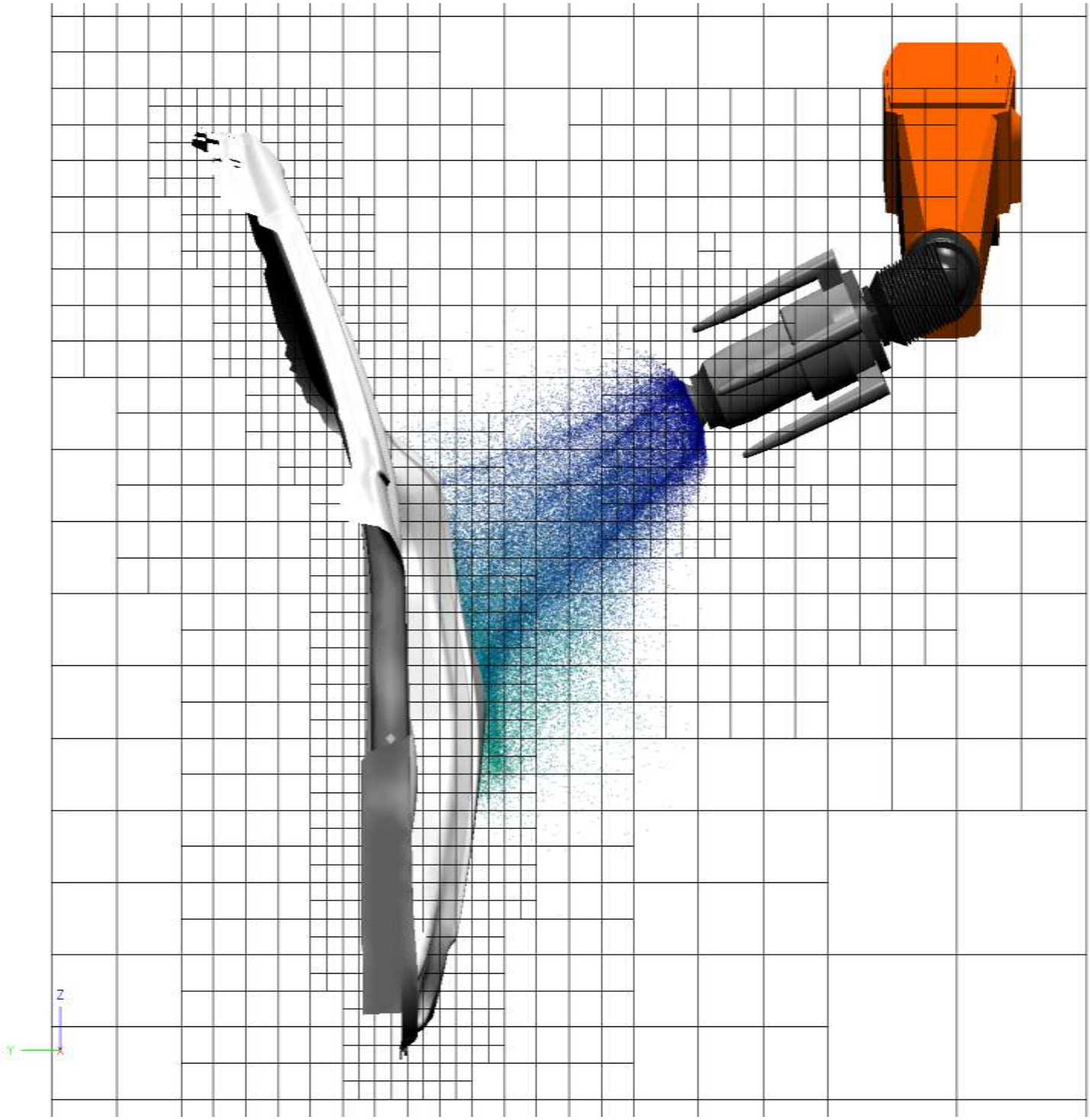
EUROPEAN SCIENCE FOUNDATION
SETTING SCIENCE AGENDAS FOR EUROPE

FORWARD LOOK

Mathematics and Industry
Success Stories - DRAFT



European Mathematical Society

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The strength of ESF lies in the influential membership and in its ability to bring together the different domains of European science in order to meet the challenges of the future.

Since its establishment in 1974, ESF, which has its headquarters in Strasbourg with offices in Brussels and Ostend, has assembled a host of organisations that span all disciplines of science, to create a common platform for cross-border cooperation in Europe.

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- Marine Sciences
- Nuclear Physics
- Polar Sciences
- Radio Astronomy Frequencies
- Space Sciences

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Foreword

This brochure shows via several success stories the crucial contribution of mathematics to the industrial creation of value and the key position of mathematics in the handling of complex systems, amplifying innovation.

Each story describes the challenge that led to the industrial cooperation, how the challenge was approached and how the solutions were achieved and implemented, and when brought together, they illustrate the versatile European landscape of projects in almost all areas of applied mathematics and across all business sectors.

Today models are used everywhere to describe real world processes in the language of mathematics. The art of modelling is to focus on the important relationships to make the model as useful as possible to the user, and modelling therefore needs support from domain specialists. Indeed, close collaboration between industry experts and academia is both highly valued by all parties and highly valuable to successful projects.

The next step after creating the mathematical model is the analysis or numerical simulation, to validate the model in comparison with experimental data and to investigate the robustness and sensitivity of the model. Once a mathematical model has been validated, then this model can be used to improve, optimize or control the process described. Model based control and optimization is a crucial element of automation in all areas of industry, often reducing the cost and time of product, process and service development and innovation.

> "In view of concrete economic and social challenges, Mathematics plays a central role. Mathematics enables innovations in the industrial and service sectors that lead to more jobs and an increasing competitiveness."
>
> Dr. Annette Schavan
> German Federal Minister
> of Education and Research

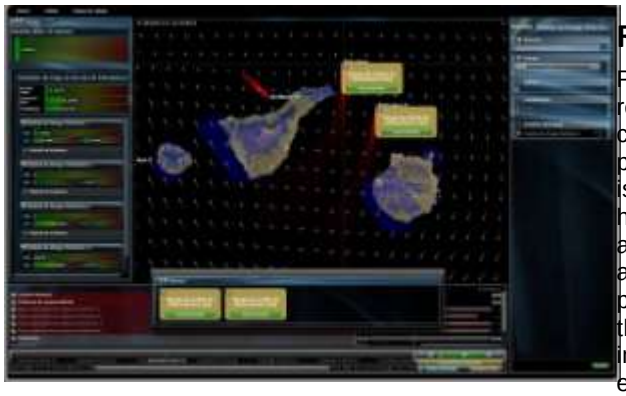
All of this is unthinkable without the existence of modern computers and information technology. However, the progress in computer technology is not alone sufficient for the future development of high technology innovation. Many of the success also rely to a large extent on the progress in the development of mathematical algorithms and tools.

Although this brochure only describes a snapshot of all the European activities in industrial mathematics, it demonstrates that the level of cooperation between academia and industry is not equally well established throughout Europe and that there exists great opportunity for more industrial challenges to be addressed with the powerful ideas and tools at the disposal of mathematicians. The impact achieved in industrial mathematics is through a wide variety of timescales and engagement mechanisms, from PhD studentships and post-doctoral research contracts to shorter-term Internships, Study Groups and consultancy contracts.

PLATEA 4D: A decision support platform

Executive summary

The Geotemporal Exploitation and Analysis Platform (PLATEA 4D) is a platform to help the decision making process necessary for optimal response planning in emergency situations such as contaminant events in the environment, accidents where hazardous substances are involved, adverse meteorological phenomena, forest fires, etc.



Challenge overview

The platform has emerged from the evolution of several Interreg III B projects like ALERMAC (an Integrated Network for monitoring, alert and management of risks from spilled pollutants and catastrophic incidents in the Maritime Zone of Macaronesia), or like SAMM 2.0 (Alert and Environmental Surveillance System), contracted by the entity in charge of the environmental care in the Canaries (Dirección General del Medio Natural, Viceconsejería de Medio Ambiente, Consejería de Medioambiente y Ordenación Territorial del Gobierno de Canarias). Currently, PLATEA 4D is being equipped with new supporting modules to face contingencies such as adverse meteorological phenomena and forest fires. This has been possible by means of an agreement with the entity in charge of the management of emergencies in the Canaries (Gestión de Servicios para la Salud y Seguridad en Canarias S.A.).

Implementation of the initiative

The initiative has been developed by the Evolutionary Computation Division (CEANI, http://ceani.ulpgc.es) with the Prof. Gabriel Winter (gabw@step.es) as scientific director and the Assist. Prof. Blas Galván (bjgalvan@siani.es) as coordinator. The CEANI team include a multi-disciplinary group of engineers, computer science graduates and scientists working together in research and innovation for industry and government departments.

The problem

Several mathematical models were developed or enhanced along the research tasks included in the initiative, among them Sea Currents Fields, Wind Fields, Transport/Chemical simulation of Oil Spills at sea and Complex Rule based Systems. The major challenges of the research were the need of models' self-adaptation to real time situations with different available data set and/or geographical zones, sometimes large sometimes short, as well as to provide solutions with the precision required by the different users which are involved at the same time in emergency scenarios.

Results and achievements

PLATEA 4D has achieved optimized results in relation to its functionality, user driven characteristics and configuration capacities. The platform has an interactive user-friendly interface. It is possible to manage a large amount of heterogeneous data that can be simultaneously analysed and processed. These characteristics allow varying the configurations of the platform, providing different functionalities and applications as the mentioned above. All of them provide an important real time support decision system in emergency situations.

Lessons learned and replicability

The main impact of PLATEA 4D lies in its capacity of integrating new modules and processing data in real time. This feature allows adapting this platform to a wide range of new different applications for public services and industry, like maintenance strategies using monitoring, logistic management, etc. PLATEA 4D can be used also as tool for collaborative research activities among partners allocated in different places (cities or countries), being ideal for large R&D projects.

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