**Deusto Unibertsitatea, Urriak 20, 2011**

basque center for applied mathematics

ikerbasque
Basque Foundation for Science

# BCAM: Emprendizaje e Innovación en la Investigación Matemática

# BCAM: Ekimena eta Berrikuntza Ikerketa Matematikoan

Enrike Zuazua Iriondo

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**www.bcamath.org**

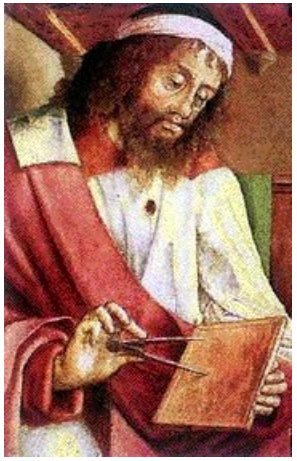
matematika mugaz bestalde

# 1.- Matematikaren jatorria eta zergatiak

# 1.- Los orígenes y porqués de las Matemáticas

# Matematika = ikasi ahal dena

La palabra “matemática” (Griego: $\mu\alpha\theta\eta\mu\alpha\tau\iota\kappa\alpha$) viene del griego antiguo $\mu\alpha\theta\eta\mu\alpha$ (máthēma), que quiere decir “aprendizaje”, “lo que puede ser aprendido”, “estudio”, “ciencia”.



Euclides 365 AC - 275 AC; Arquímedes 287 AC - 212; Al-Kitab al-mukhtasar 783 DC.

Unibertsoa Matematikaren hizkuntzan idatzita dago.

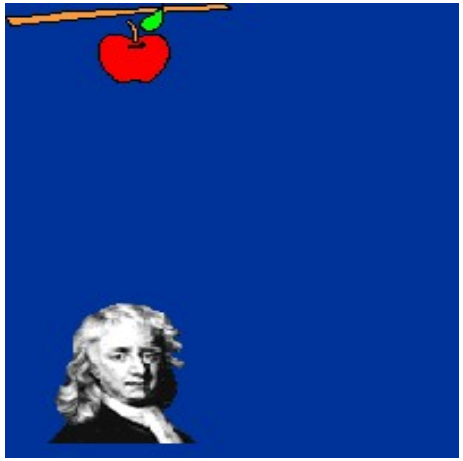
El universo está escrito en lenguaje matemático.

Galileo Galilei (1564-1642).

Estableció los fundamentos de la moderna ciencia. Uno de los fundadores de las ciencias experimentales, astronomía,...

Naturak bereganako adostasuna eta oreka azaltzen du.

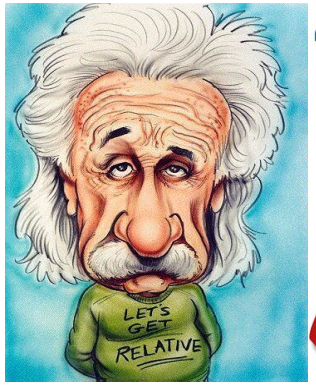
La naturaleza es verdaderamente coherente y confortable consigo misma.



Isaac Newton (1642-1727). Matemático y físico británico, considerado uno de los más grandes científicos de la historia, que hizo importantes descubrimientos como la ley de la gravedad.

Nola daiteke ba, Matematika, esperientziatik at, gizakiaren pentsamenduaren produktu hutsa izanik, errealitatea horren ondo deskribatzeko baliagarria izatea?

¿Cómo es posible que la matemática, un producto del pensamiento humano independiente de la experiencia, se adapte tan admirablemente a los objetos de la realidad?



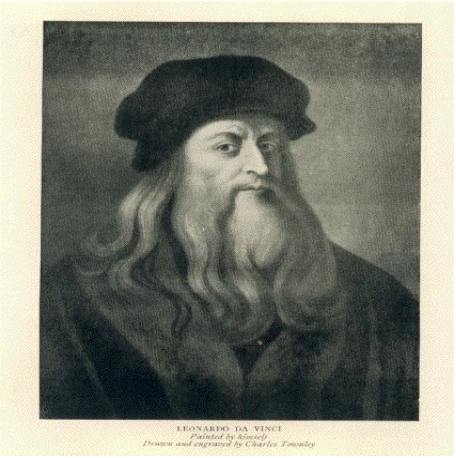


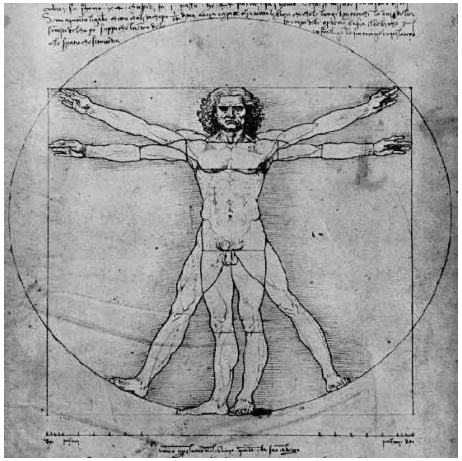
Albert Einstein (1879-1955)

Ez dago zihurtasunik matematika aplika ezin bada.

No hay certidumbre allí donde no es posible aplicar ninguna de las ciencias matemáticas ni ninguna de las basadas en las matemáticas.

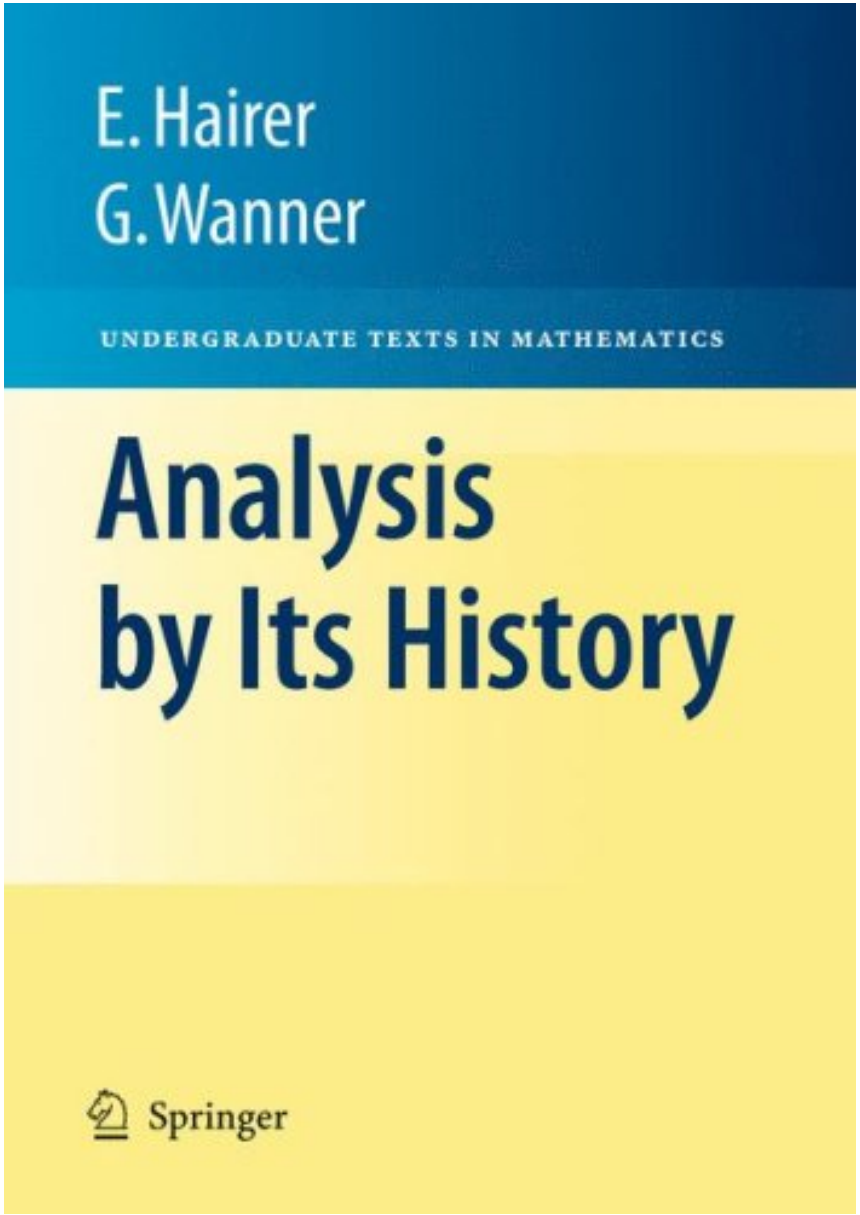
Leonardo Da Vinci, Vinci (1452) - Cloux (1519)



# 2.- Matematikaren berrikuntza lan eten gabea

# 2.- Matemáticas: El esfuerzo constante por la innovación


E. Hairer
G. Wanner
UNDERGRADUATE TEXTS IN MATHEMATICS
Analysis
by Its History
Springer

Leonhard Euler (1707-1783) dió con la ecuaciones que llevan su nombre para el movimiento de los fluidos perfectos, en ausencia de viscosidad:

$$u_t + u \cdot \nabla u = \nabla p.$$

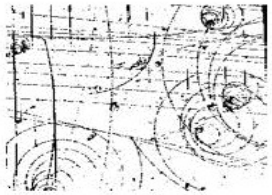
Pero D'Alembert observó que según ella los pájaros no podrían volar.

Hubo que esperar a los trabajos de Claude Louis Marie Henri Navier (1785-1836) y Sir George Gabriel Stokes (1819-1903) para dar con el modelo completo que incorpora el término de viscosidad:

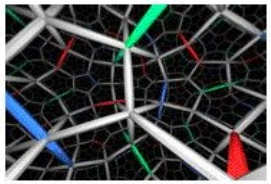
$$u_t - \nu \Delta u + u \cdot \nabla u = \nabla p.$$

Fluidoen konportaera dela eta horrenbeste arazo matematiko zailak guztik irekirik daude oraindik ere: ura, odola, airea,...

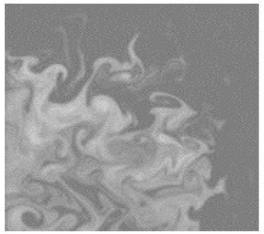
Las propiedades de las soluciones de esta ecuación que describen el comportamiento de fluidos tan importantes como el aire, el agua o la sangre, aún están por entender....



Yang-Mills and Mass Gap



Poincaré Conjecture



Navier-Stokes Equation

Birch and Swinnerton-Dyer Conjecture

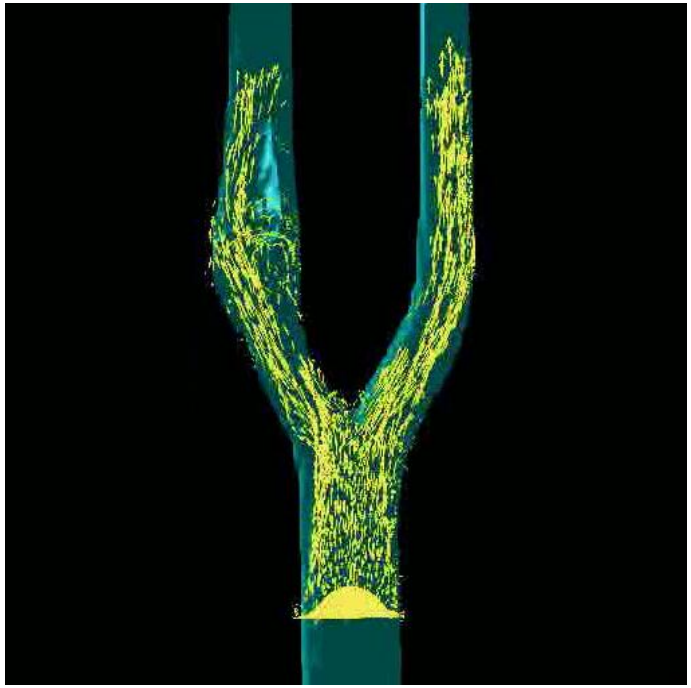
Riemann Hypothesis

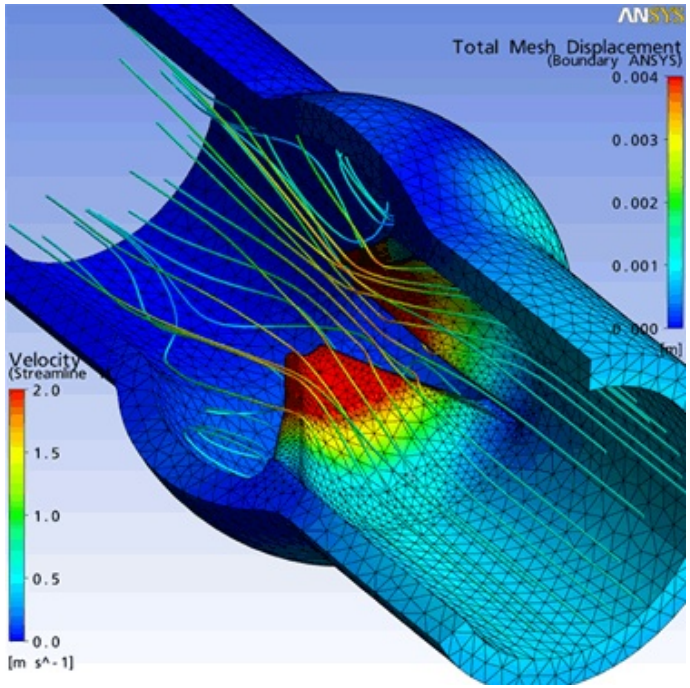
P vs NP Problem

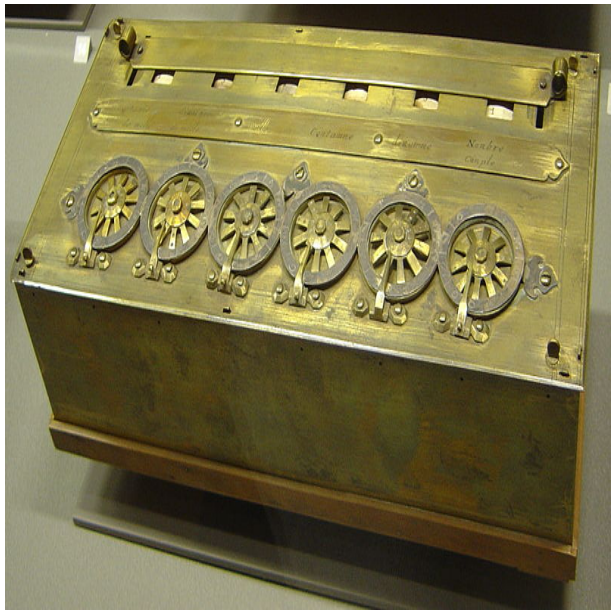
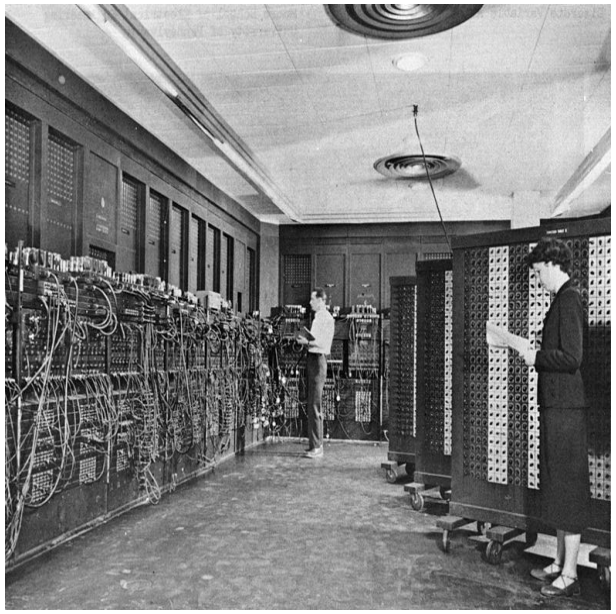
Hodge Conjecture

Milakadako arazoak...

La simulación numérica a través de los cada vez más potentes ordenadores permite seguir adelante...






Pascalina, Blaise Pascal, 1645; ENIAC: Electronic Numerical Integrator And Computer, 1946; Macbook Air, 2008.

# 3.- Matematikaren begirada sakona

# 3.- La profunda mirada de las Matemáticas

Me parece que el poeta ha de ver lo que otros no ven, mirar más hondo que los demás. Y el matemático ha de hacer lo mismo

Sofia Kowalewskaja (1850 - 1891)

Our imagination is stretched to the utmost, not, as in fiction, to imagine things which are not really there, but just to comprehend those things which are there.

Richard Phillips Feynman (1918 – 1988);

Fisika Nobel Saria 1965

# 4.- Erronka

# 4.- El gran reto

## Agenda UE 2020

.. un nuevo mercado socioeconómico sostenible, una economía más inteligente, más verde, en la que nuestra prosperidad venga de la innovación y en la que los recursos se usen mejor y en la que el ingrediente principal sea el conocimiento.

## Ezagutza = osagai nagusia

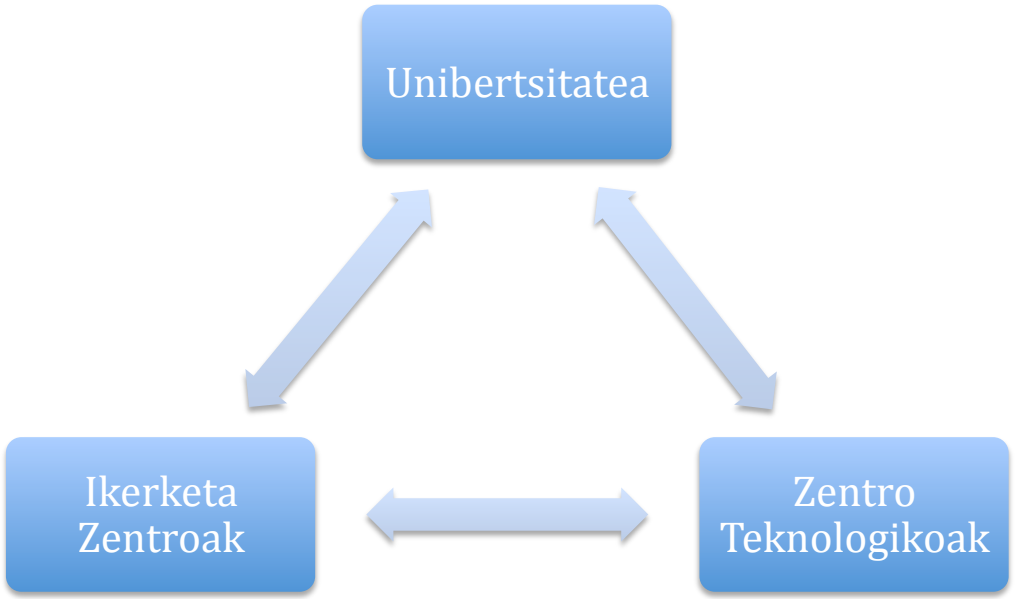
## Informe de la European Research Council (ERC)


.. nuestra economía y sociedad necesitan de cambios dramáticos en todos los frentes... en el número de start-ups basados en tecnología...

... el conocimiento y en particular el conocimiento científico, es la base de la innovación...

Aunque no suficiente, el acceso a instituciones de investigación de primer nivel es una condición necesaria para una innovación vigorosa....

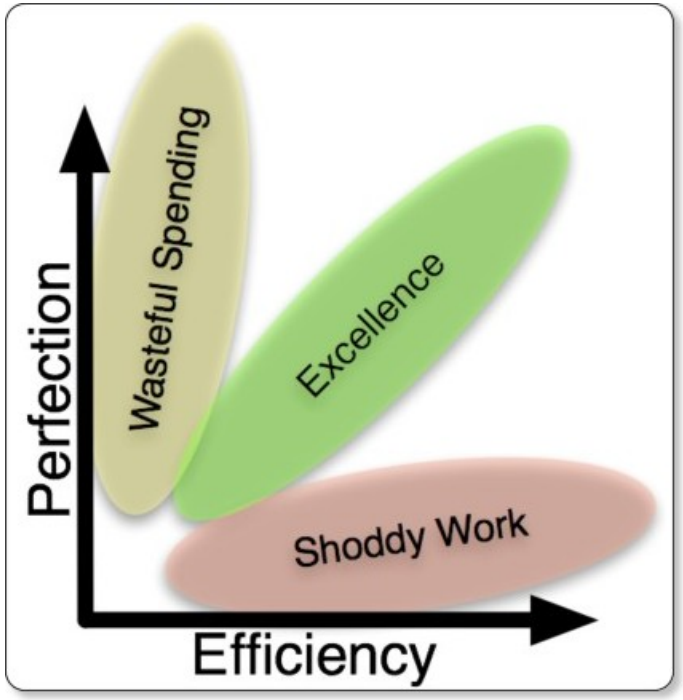
# Ezagutzaren triangelua / Triángulo del conocimiento



Necesitamos infraestructuras de primer nivel...

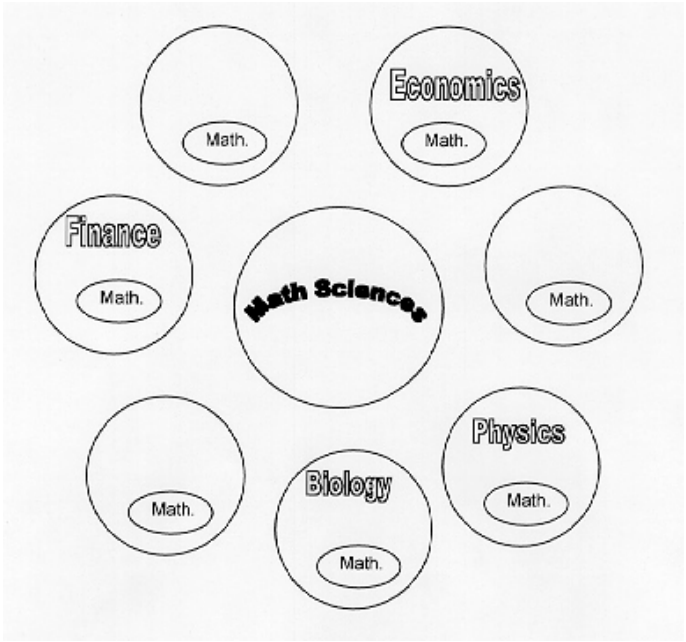
E infraestructuras no son sólo edificios y redes de comunicaciones sino, sobre todo, **personas**...

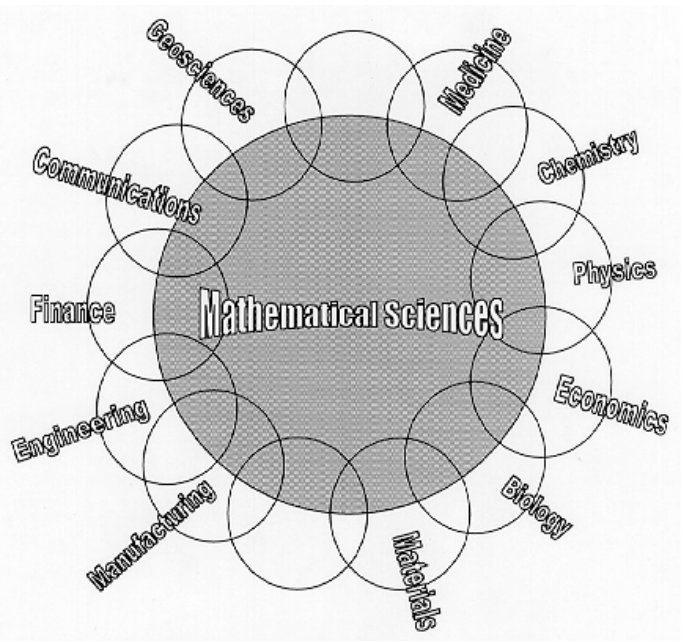
Ningun Centro puede ser excelente en todo, pero todas pueden serlo en algo....



**Una de las claves:** Programas de postgrado de excelencia internacional

# Eta Matematika?




Report of the assessment panel of the U.S. Mathematical Sciences, NSF, March 1998. W.E. Odom Lieutenant General, USA, Retired.

> Partly because our computational capabilities have grown enormously, and partly because abstract mathematical structures guide scientists through the labyrinth of new knowledge, mathematics and mathematical methods permeate every area of current science.

Juan J. Manfredi, University of Pittsburgh, Chair of BCAM Scientific Committee.

Inork ez du gure ordez egingo!

# 5.- Erantzuna: Ikerketa Matematikorako Zentroak

# 5.- Una respuesta: Centros de Investigación Matemática

CRM, Centre de Recherches Mathématiques, Université de Montréal (Montréal PQ, Canada)

CIRM, Centre International de Rencontres Mathématiques (Marseille, France)

Centre de Recerca Matemática (CRM, Bellaterra, Barcelona, Spain)

Clay Mathematics Institute (Cambridge MA, USA)

Courant Institute of Mathematical Sciences (New York NY, USA)

EIMI, Euler International Mathematical Institute, (St. Petersburg, Russia)

Fields Institute, University of Toronto (Toronto ON, Canada)

IHES, Institut des Hautes Études Scientifiques (Bures-sur-Yvette, France)

IMA, Institute for Mathematics and its Applications (Minneapolis MN, USA)

IMPA, Instituto de Matemática Pura e Aplicada (Rio de Janeiro, Brazil)

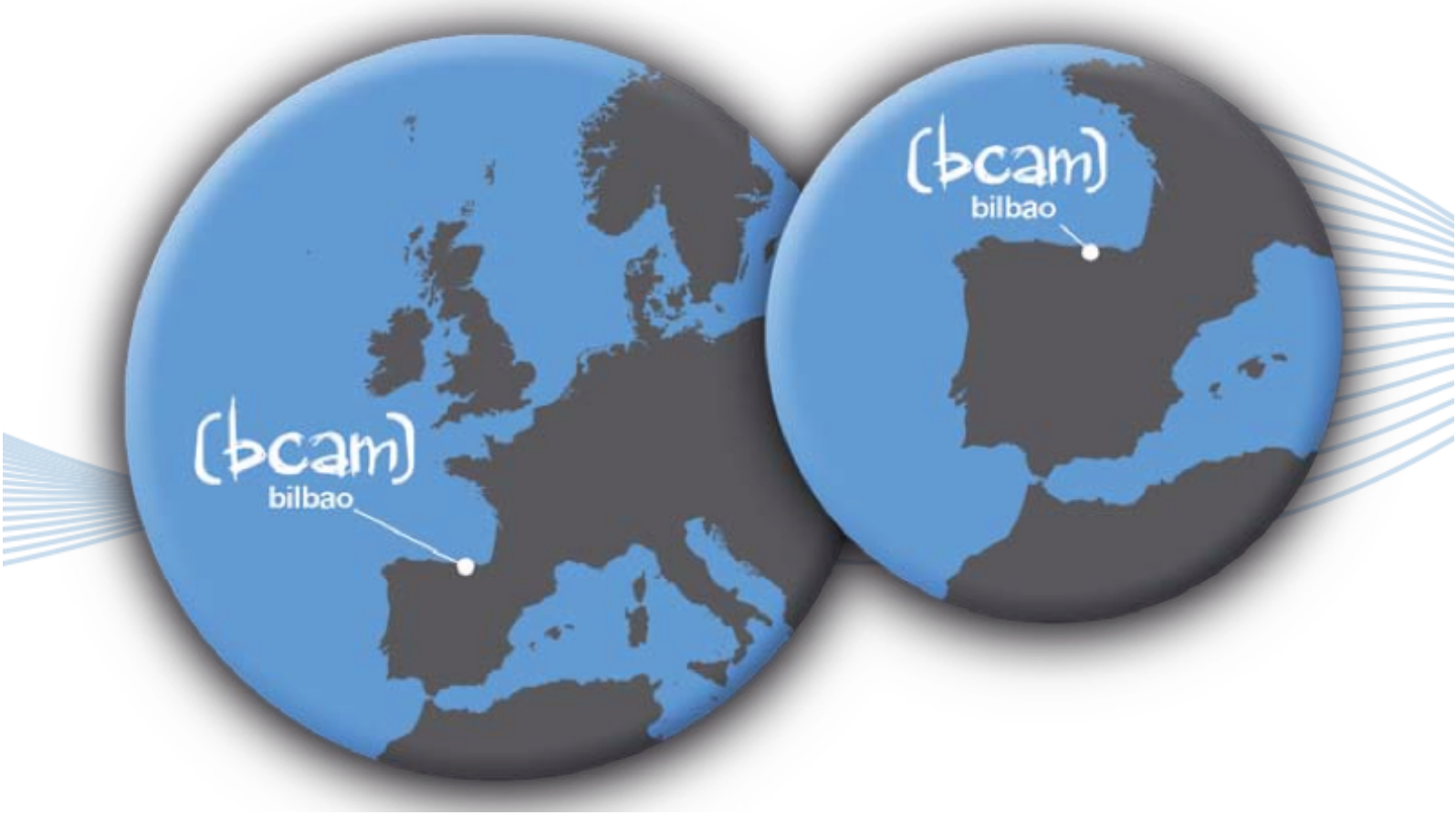
.....

Eta Euskal Herrian?

¿Y en Euskadi?

Irailak, 2008

Irailak, 2008


(bcam)
bilbao
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basque center for applied **mathematics**

INTRANET

*"We understand Applied Mathematics both as a way of getting into the depth of mathematics and also of interacting with all other scientists and R&D agents.*

*At the heart of the Basque Country, Bilbao is the right place for attaining these two objectives and BCAM will facilitate them with the right atmosphere, infrastructure and vision."*

Enrique Zuazua (Scientific Director).

e^N | e^U | e^S

- HOME
- THE CENTER
- RESEARCH
- PEOPLE
- VISITORS
- JOB OFFERS
- INTERNSHIPS
- ACTIVITIES
- COURSES
- COMPUTATIONAL RESOURCES
- SIMULATIONS

## applied mathematics

The Department of Education, Universities and Research of the Basque Government, The University of the Basque Country and Ikerbasque have promoted BCAM - The Basque Center for **Applied Mathematics**, a world-class interdisciplinary research center on Applied Mathematics.

The center started operations in September 2008 and is located in Bilbao, Basque Country (Spain).

›› read more

**mathematicians**
beyond frontiers

### Upcoming Activities

**BCAM Seminar Solutions of nonlinear PDEs in the sense of averages**
**Juan José MANFREDI**
**2011-10-20**

**BCAM Seminar Matrix-valued $L^1$-optimal controls in the coefficients of linear elliptic problems**
**Peter KOGUT**
**2011-10-28**

**BCAM EHU/UPV Basque Colloquium in Mathematics and**

EUSKO JAURLARITZA
GOBIERNO VASCO
HEZKUNTZA, UNIBERTSITATE ETA IKERKETA SAILA
DEPARTAMENTO DE EDUCACIÓN, UNIVERSIDADES E INVESTIGACIÓN

**FINANCIAL SUPPORT**
Basque Government
Department of Education, Universities and Research

**PARTNERS**

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Basque Foundation for Science

BFA DFB Bizkaiko Foru Aldundia Diputación Foral de Bizkaia

innobasque
berrikuntzaren euskal agentzia
agencia vasca de la innovación

eman ta zabal zazu
Universidad del País Vasco
Euskal Herriko Unibertsitatea

**COLLABORATORS**

Bilbao
UDALA
AYUNTAMIENTO

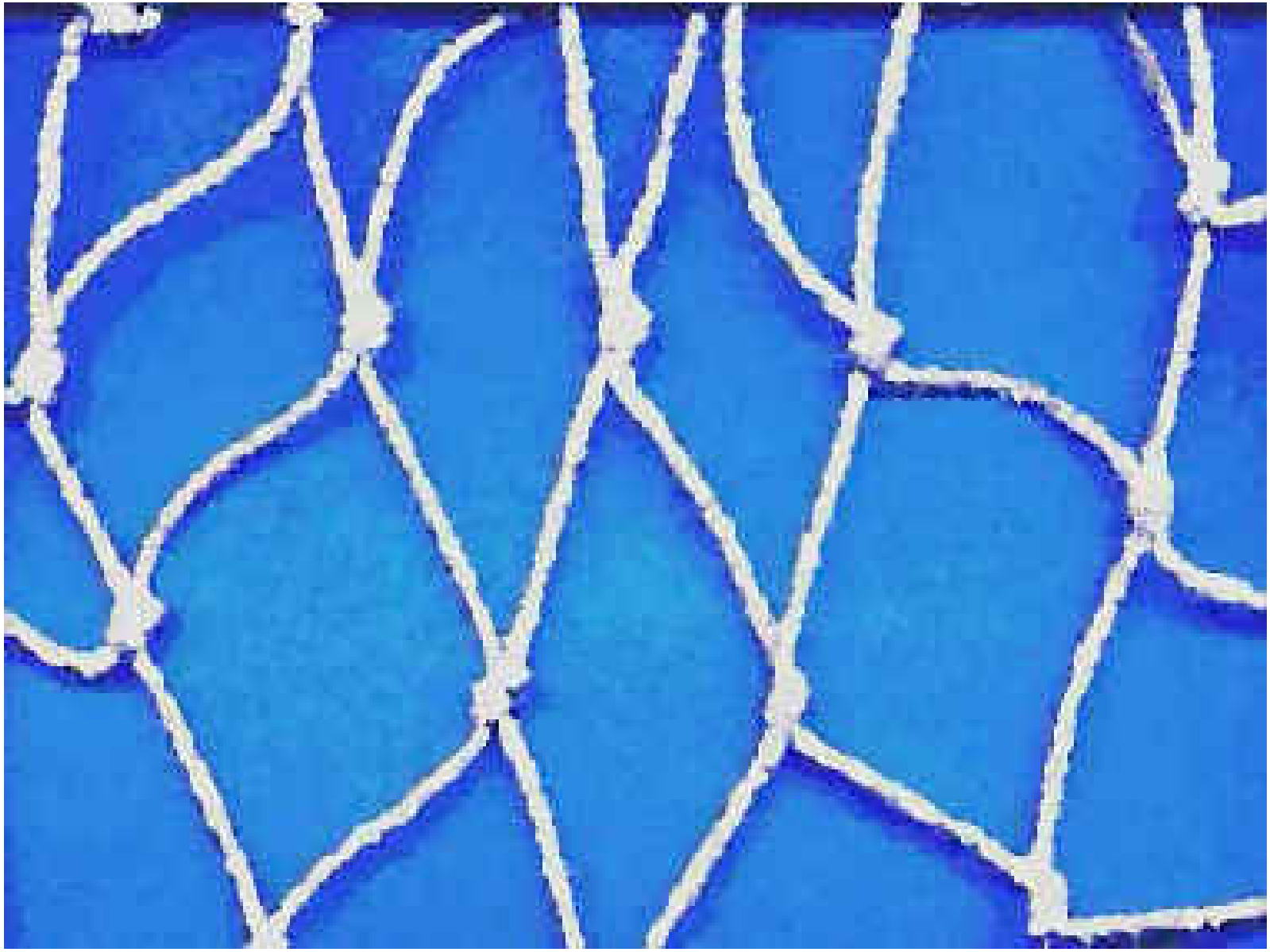
bizkaia
:::xede

BFA DFB Bizkaiko Foru Aldundia Diputación Foral de Bizkaia

- Perform research in the frontiers of mathematics
- Train and attract talented scientists
- Interact with industry and RDI agents
- Disseminate mathematics and its applications within society
- Strengthen the Basque science and technology system
- **Become a relevant node in the international mathematics research network**

# 6.- Sarea

# 6.- La red







**Material Physics Center**
**UPV / EHU - CSIC**

# BERCs-Basque Excellence Research Centers Strategy

Designed by the Basque Government through Ikerbasque

- **To build new scientific capabilities in the Basque Country**

- Constituted by frontier research centers, aiming to contribute to the leadership of the Basque Country as a scientific pole, at an international level

- To develop frontier research under international research performance parameters

- To attract talented scientist

- To train researchers in every stage of their careers

- To communicate and disseminate the knowledge created within the different activities of the centers

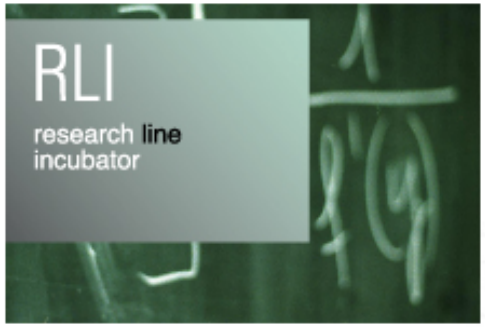
BCAM Scientific Committee Meeting, September 2010

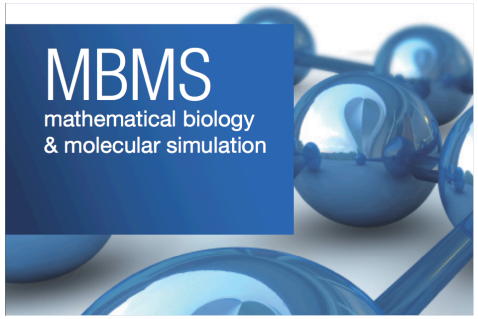

PDE
partial differential
equations,
numerics and control

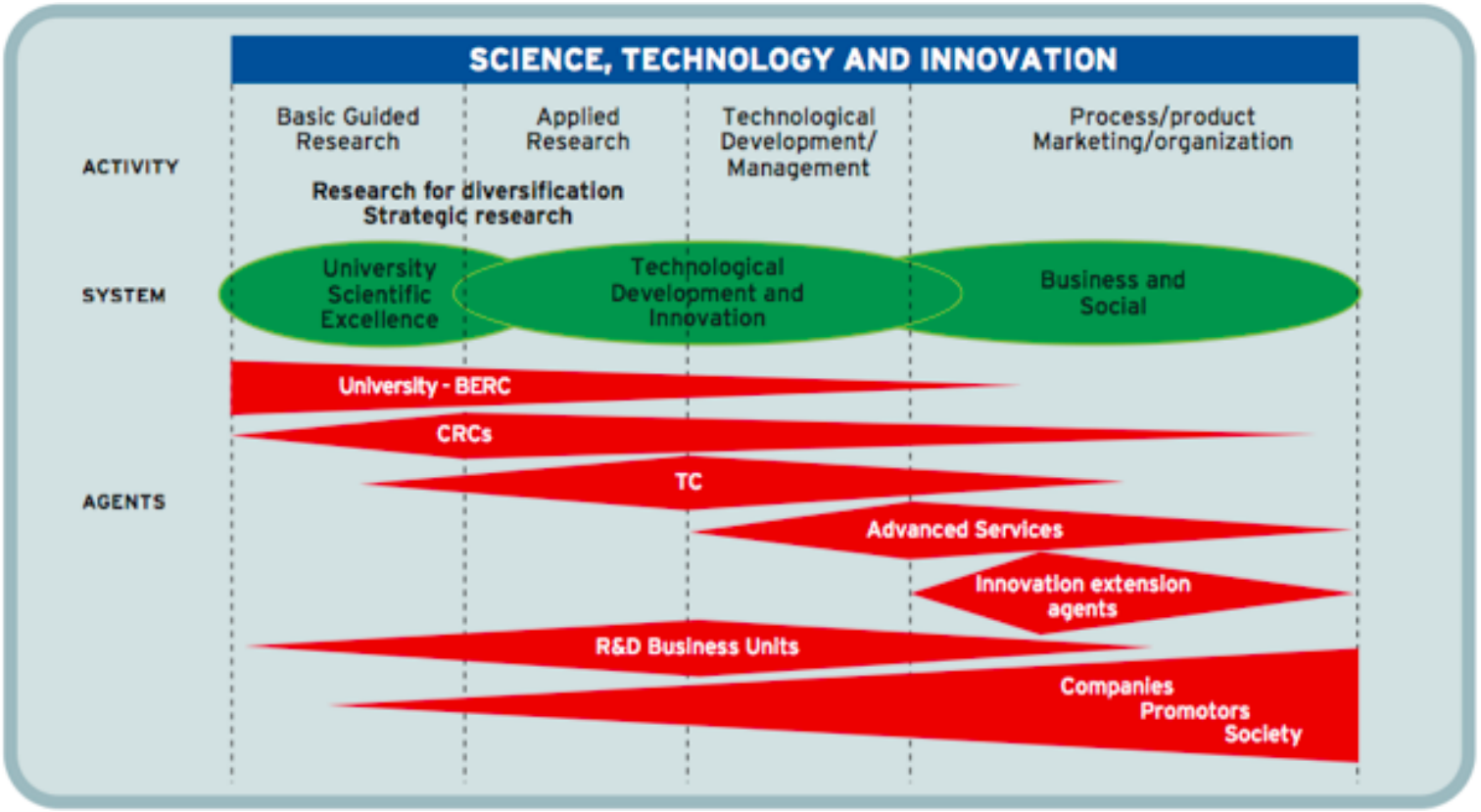

NET
network design,
analysis and
optimization


CM
computational
mathematics


CFD
Computational fluid
dynamics


RLI
research line
incubator


MBMS
mathematical biology
& molecular simulation




The Basque Science System

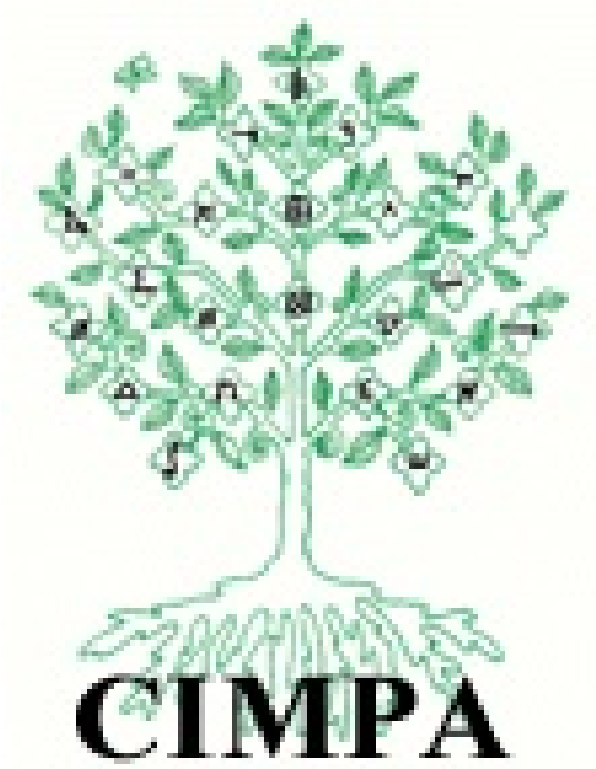
**International Network of Cooperating Institutions**

- Centro de Modelamiento Matemático,Chile
- Tata Institute, Bangalore, India
- Kyushu University, Fukuoka, Japan
- Laboratrio Nacional de Computao Cientfica, Petrópolis, Brazil
- LEM2I, Mediterranean Network, CNRS, Nice
- Chinese Academy of Sciences, Beijing

- Fujitsu, UK
- Université Laval, Quebec
- University of Maryland, US

**And also with developing countries...**

Every morning in Africa, a gazelle wakes up. It knows that it must run faster than the fastest lion, or it may be killed.
Every morning in Africa, a lion wakes up. It knows that it must run faster than the slowest gazelle or it will starve to death.
It doesn't matter whether you are a lion or a gazelle. When the sun rises, you had better be running.
[African Proverb]




CIMPA, Centre International de Mathématiques Pures et Appliquées, Nice, France.

# 7.- Matematikari ekiten: diseinua aeronautikan

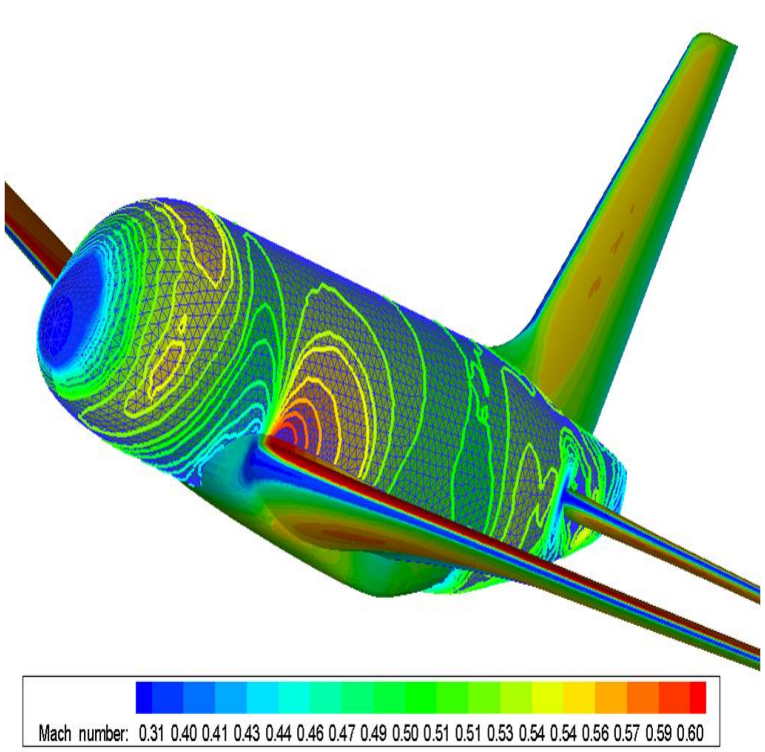
# 7.- Matemáticas en acción: Diseño aeronáutico

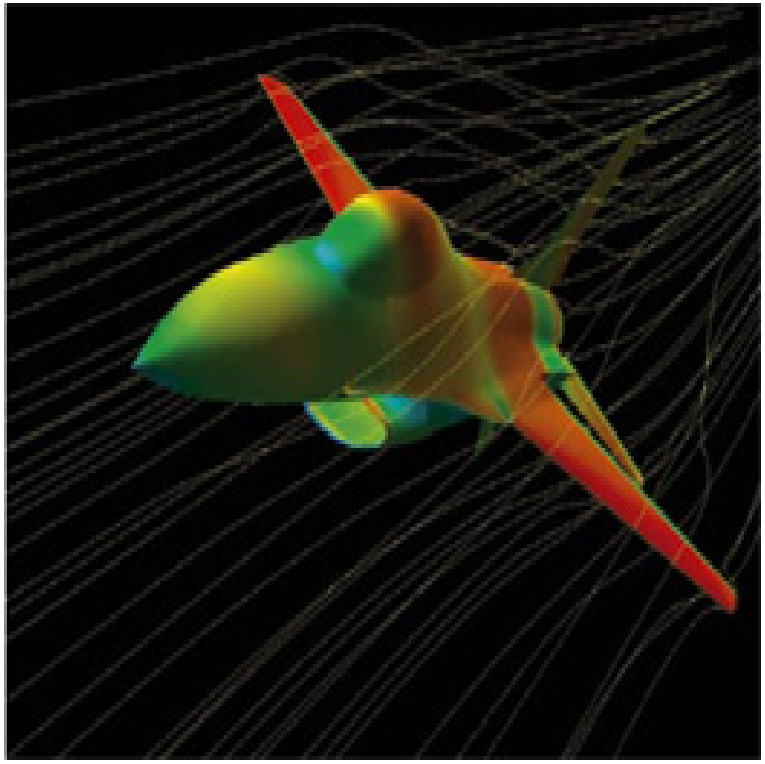
## Diseño Óptimo en Aeronáutica.

- Objetivo: Modificar la forma de la aeronave para que mejore su rendimiento, seguridad, ligereza, habitabilidad,...
- Punto de vista: El del túnel de viento: La aeronave está fija mientras el aire fluye entorno a ella.
- Variaciones: Al modificar la forma de la aeronave cambia el modo en que el aire fluye en su entorno, y entonces cambia la presión y rozamiento que este ejerce sobre ella, modificando así sus propiedades arodinámicas.

## Herramientas:

- Mecánica de fluidos computacional: Permite simular en el ordenador cómo fluye el aire en torno a una forma de la cavidad dada.
- Optimización: Permite construir un algoritmo iterativo que, a partir de una forma dada, la vaya mejorando paulatinamente...


Mach number: 0.31 0.40 0.41 0.43 0.44 0.46 0.47 0.49 0.50 0.51 0.51 0.53 0.54 0.54 0.56 0.57 0.59 0.60



El método consiste por tanto en:

Minimizar

$$J(\Omega^*) = \min_{\Omega \in \mathcal{C}_{ad}} J(\Omega)$$

donde $\mathcal{C}_{ad} =$ es la clase formas admisibles $\Omega$, y $J =$ es el funcional coste (reducción de la resistencia, aumento de la sustentación, consumo de combustible,..)

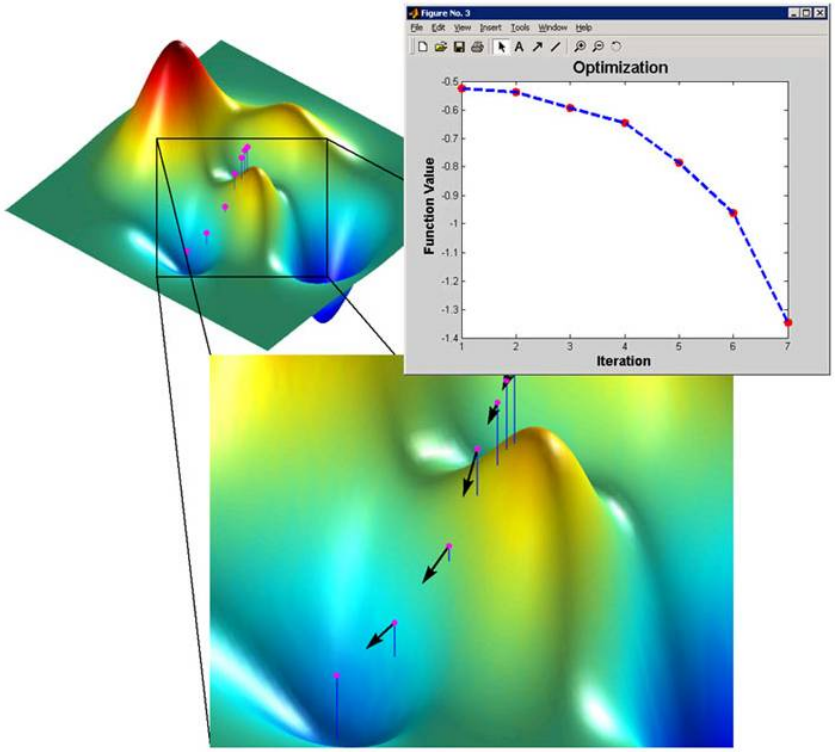
$J$ depende de $\Omega$ a través de $u(\Omega)$, solución de un modelo de fluidos en torno a la cavidad (ecuaciones de Navier-Stokes)

Pero minimizar un funcional tan complejo como este no tiene por qué ser fácil.

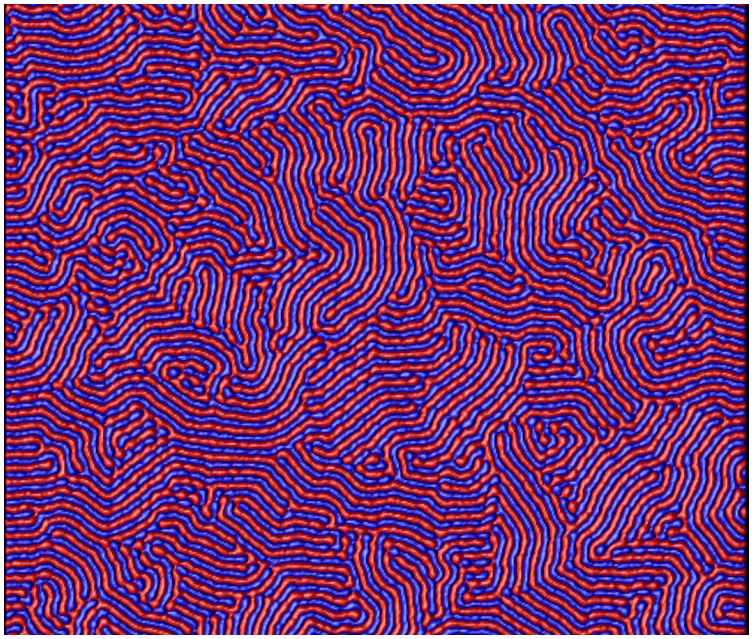
Métodos deterministas versus estocásticos.

Deterministas: Métodos gradiente.

$$u_{k+1} = u_k - \rho \nabla J(u_k).$$

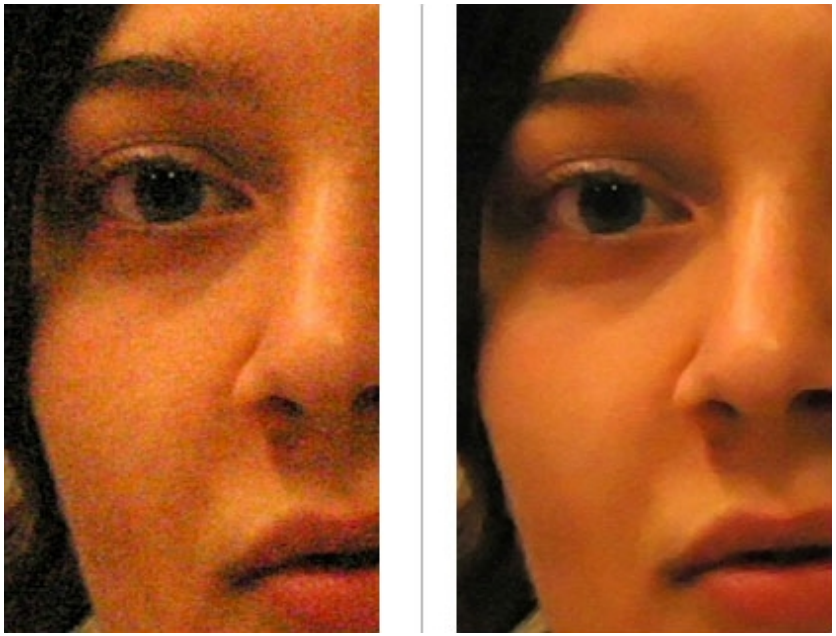


Estocásticos: Métodos Monte-Carlo.

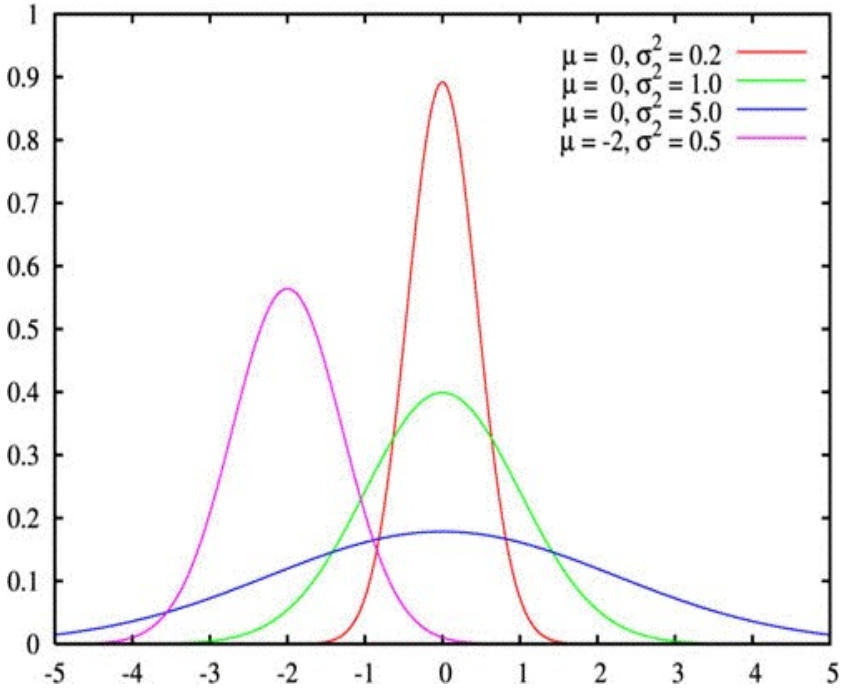


Optimizazioaren beste aplikazio batzuk: zarataren murrizpena.

Otras aplicaciones de la optimización: La reducción del ruido.



Gauss-en filtroak / Filtros gaussianos:




$$u(x) = [G(\cdot) \star f(\cdot)](x); \quad G(x) = (4\pi)^{-N/2} \exp(-|x|^2/4).$$

# 8.- BCAM: Eredu eraginkor eta berritzailea

# 8.- BCAM: Modelo de emprendizaje innovador

We understand Applied Mathematics both as a way of getting into the depth of mathematics and also of interacting with all other scientists and R&D agents.

At the heart of the Basque Country, Bilbao is the right place for attaining these two objectives and BCAM will facilitate them with the right atmosphere, infrastructure and vision.

Enrique Zuazua (Scientific Director)

matematika mugaz bestalde

Ruper Ordorika: 37 Galdera Mugaz Bestalde Dudan Kontaktu Bakarrari, (Bernardo Atxaga)

Esaidan, zoriontsuak al zarete mugaz bestaldeko biztanleak?

.....

Mugaz bestaldean, hostoek ematen al diete babesa fruituei? Ba al dago marrubirik? Arrain abisalek ba al dute aurresentipenik eguzkiaz?

.....

Asko al dira, asko al zarete mugaz bestaldeko erresuma hartan? Egunero kaletik ikusten dudan jende hau, han bizi al da?

## 37 Preguntas a mi único contacto al otro lado de la frontera

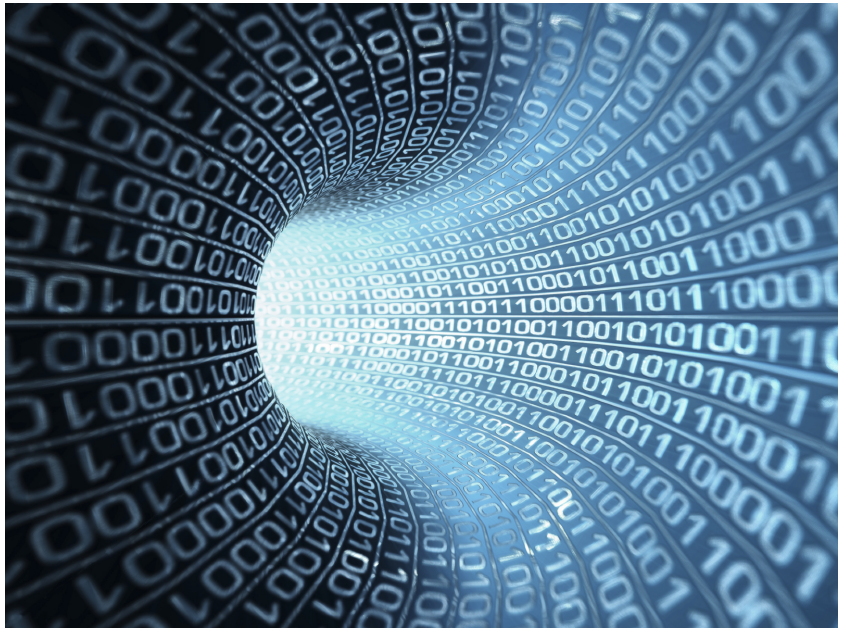
Dime, ¿es feliz la gente allá al otro lado de la frontera?

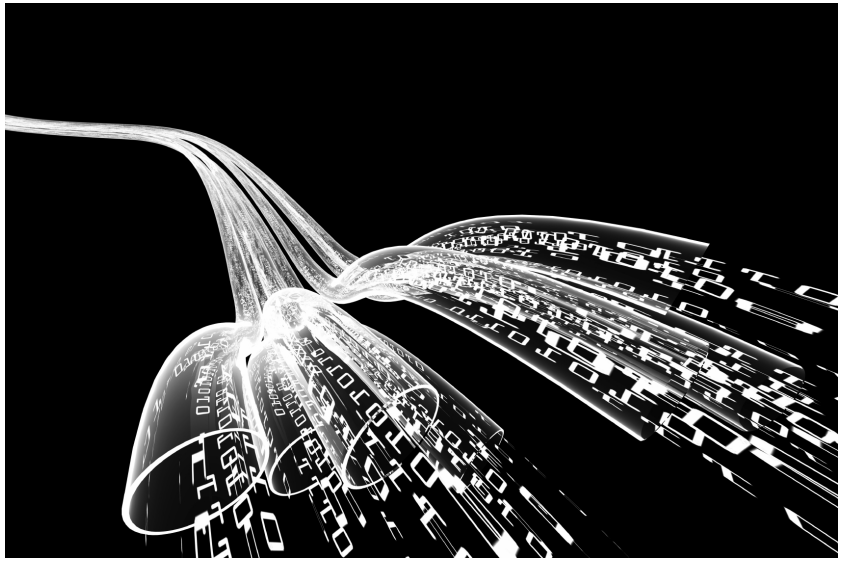
.....

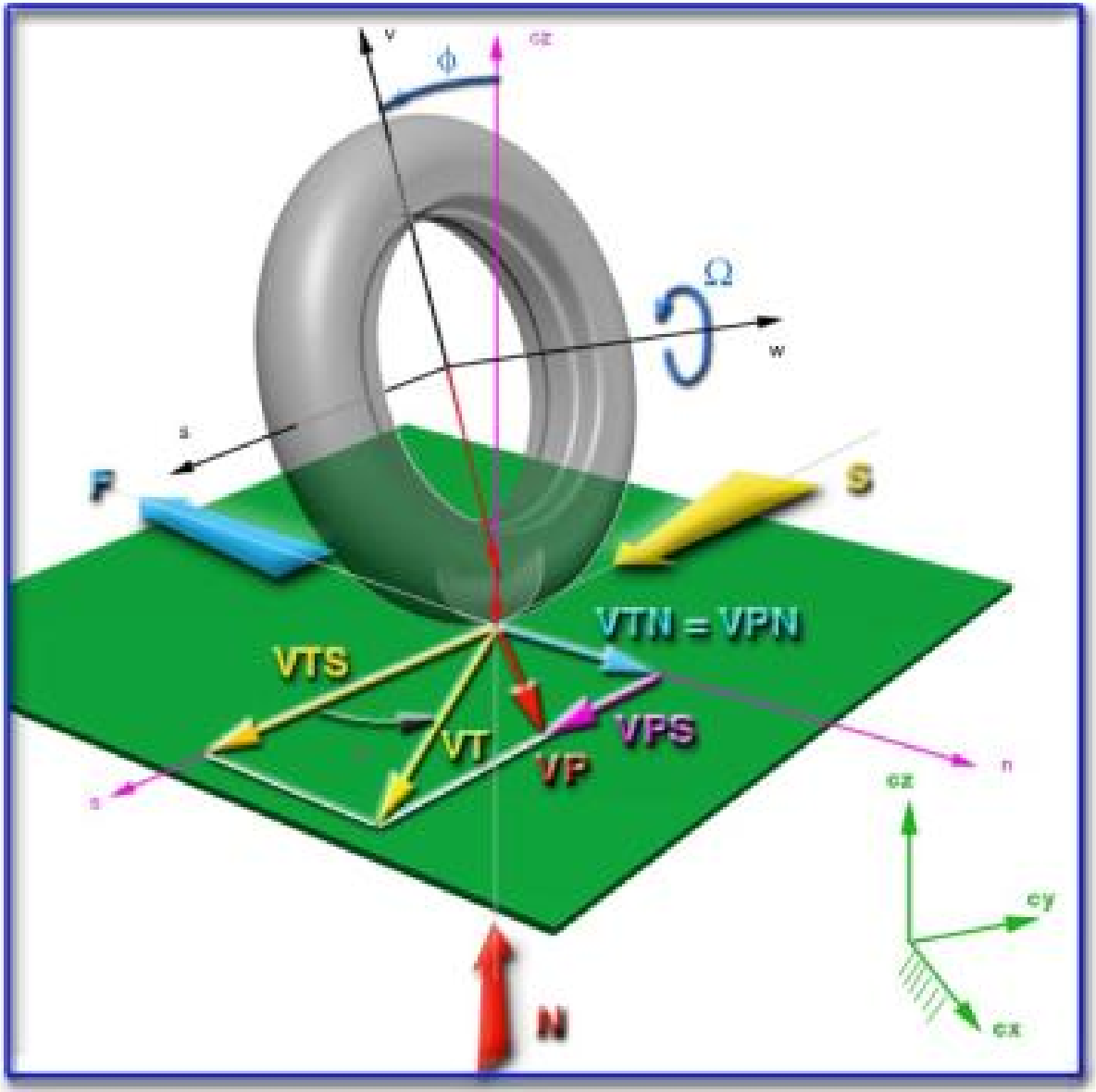
Al otro lado de la frontera ¿Protege la hoja al fruto? ¿Hay fresas? ¿Tienen los peces abisales presentimientos acerca del sol?

.....

¿Son muchos, sois muchos los habitantes del otro lado de la frontera? Esta gente que veo todos los día por la calle, ¿vive allá?



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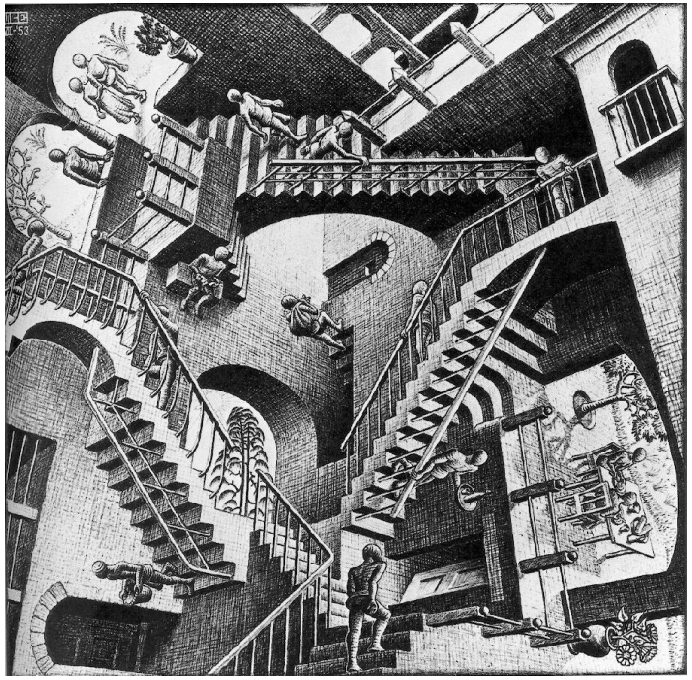
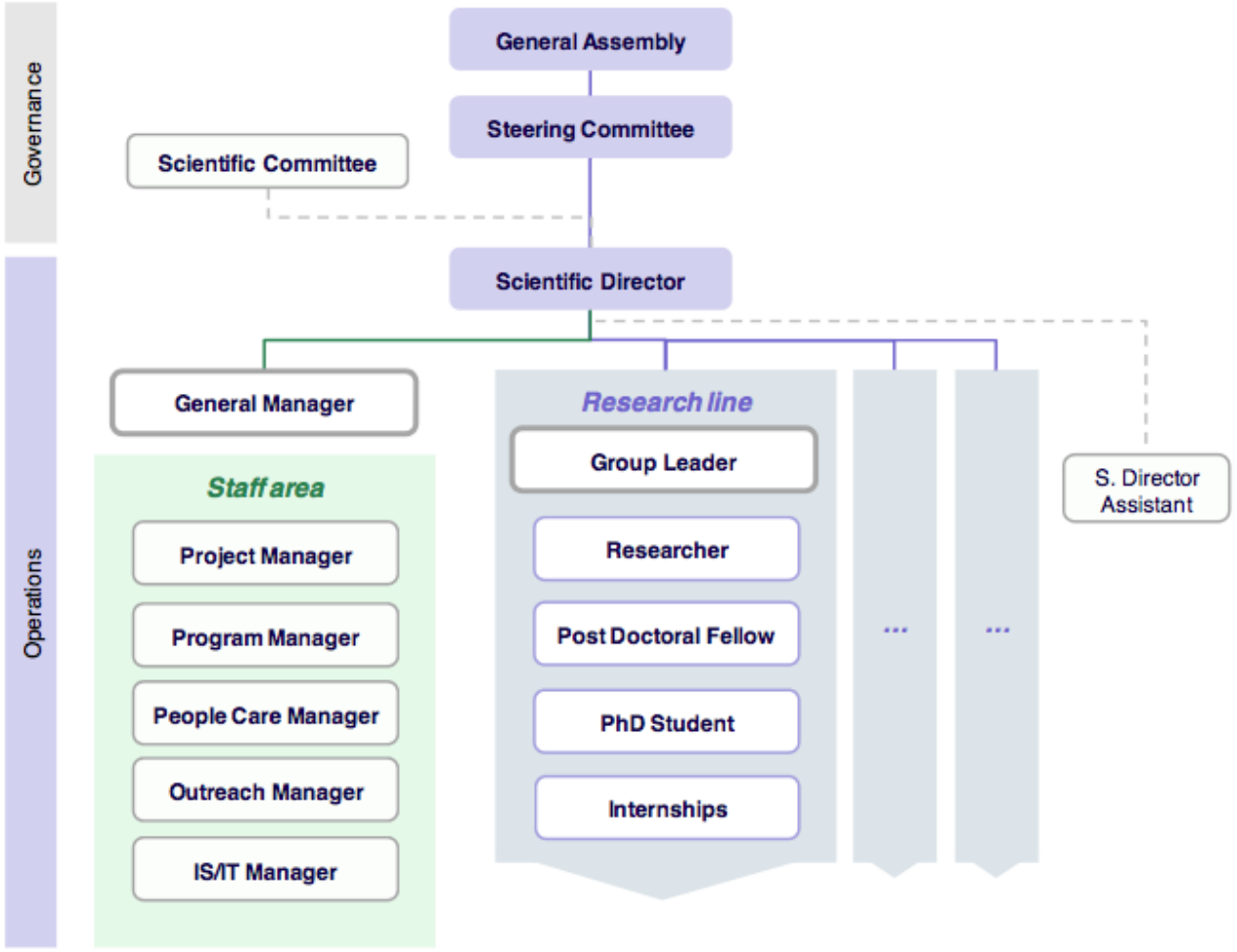


Maurits Cornelis Escher (Países Bajos,1898 - 1972)


# ROLES DEFINITION MANUAL

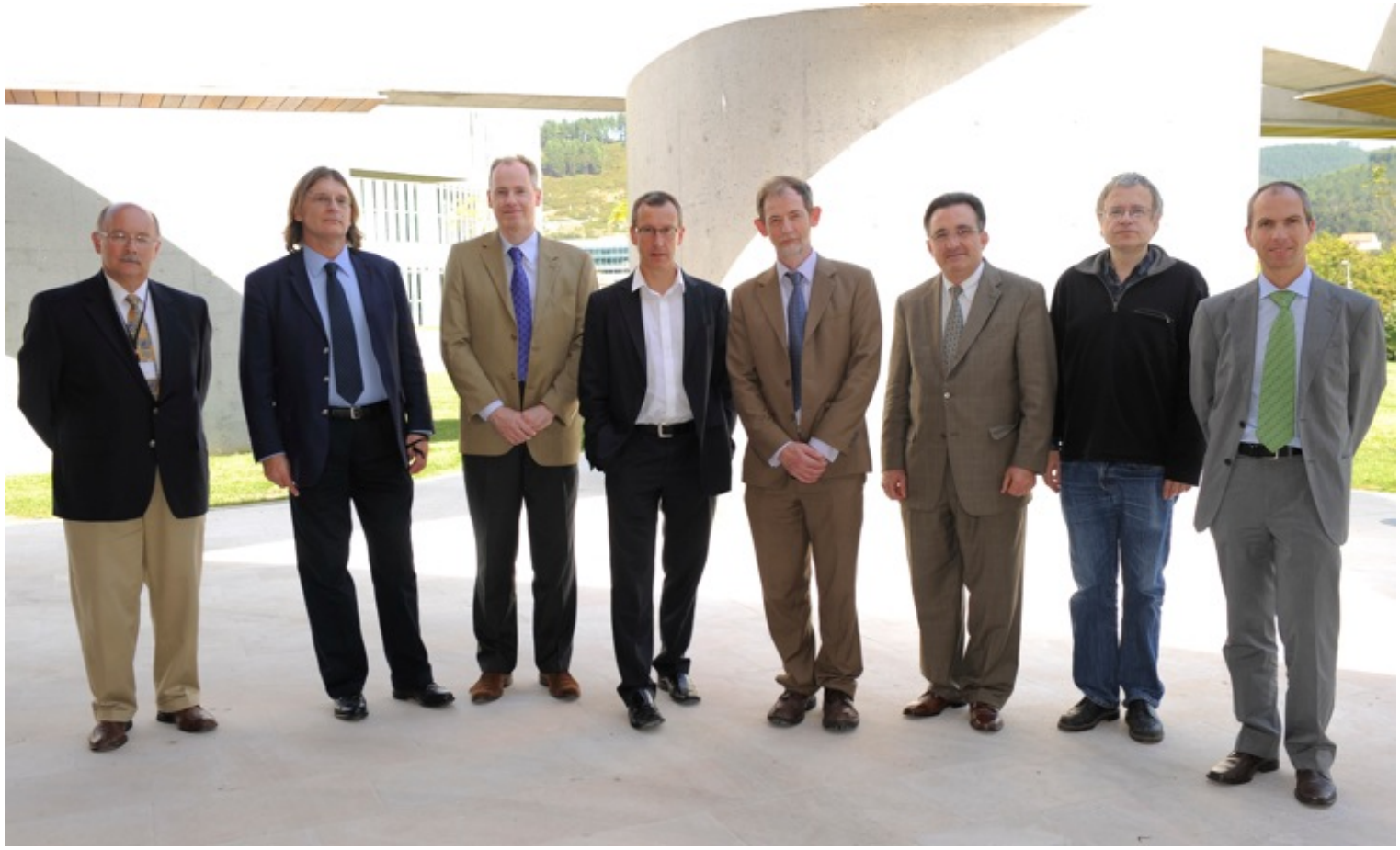
# BCAM ORGANIZATION CHART



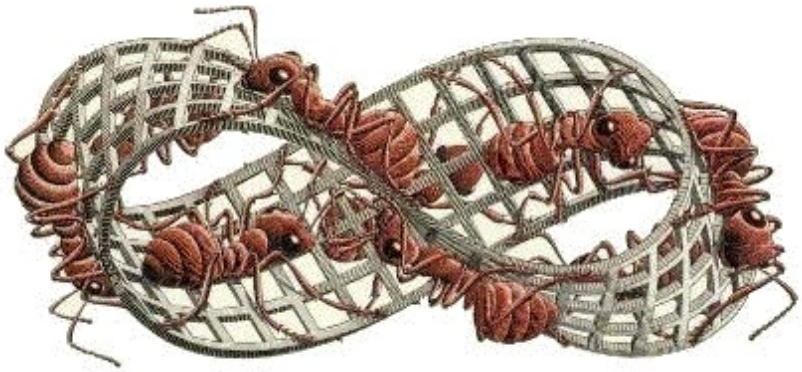
Nanuak erraldoien sorbaldetan

## BCAM Scientific Committee

- Juan José MANFREDI – U. Pittsburgh (USA) [President]
- Sir John BALL – U. Oxford (UK)
- Sem BORST – Bell Labs (USA) / Technische U. Eindhoven (Netherlands)
- Jean-Michel CORON – U. Pierre et Marie Curie & Institut Universitaire de France (France)
- Leszek F. DEMKOWICZ – U. Texas at Austin (USA)
- Pierre-Louis LIONS – Collège de France (France)

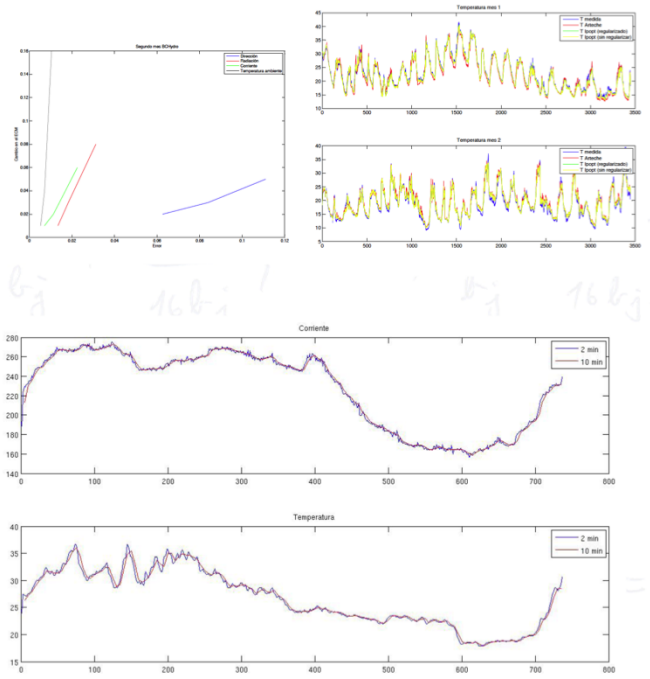


BCAM Scientific Committee



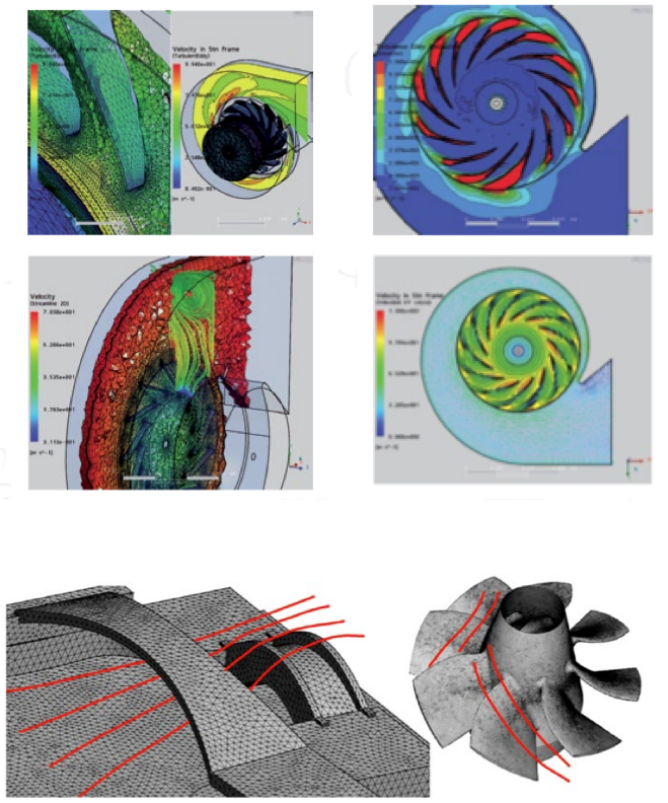
## ARTECHE

- Project: Ampacity Calculation Algorithm
- Goal: To develop a computational and visualization platform for parameter identification in electrical networks
- Interest for industry:
- Interest for BCAM: Electrical networks, modelization, differential equations, visualization, simulations, parameter identification



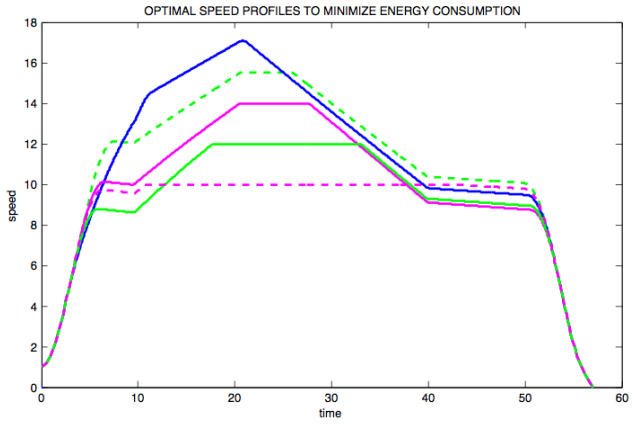
## BALTOGAR

- Project: Computational fluids mechanics and applications to turbomachinery
- Goal: To launch a research line in CFD
- Interest for industry: To develop a simulation code of turbo-machinery
- Interest for BCAM: CFD, Simulation, Computational Mathematics, PDE



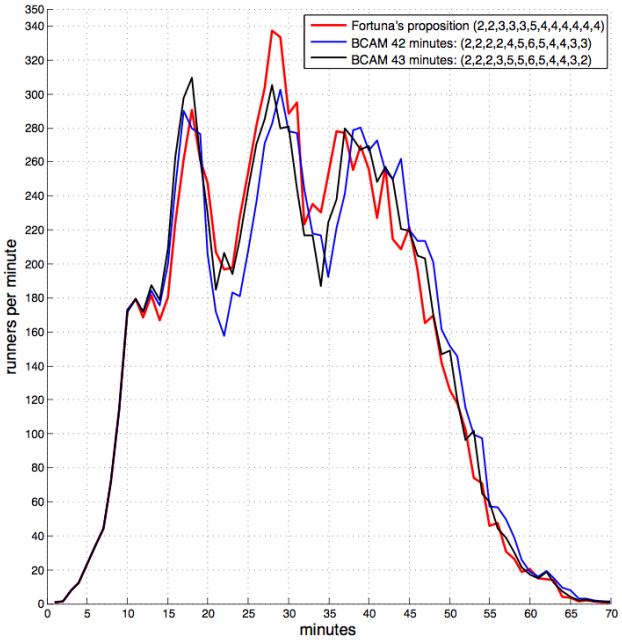
## INGETEAM

- Project: Energy minimization in Railway System
- Goal: Characterize optimal speed profile to minimize energy
- Interest for industry: Energy represents a large percentage of the running costs in railway systems
- Interest for BCAM: Real-life application that poses a scientific challenge



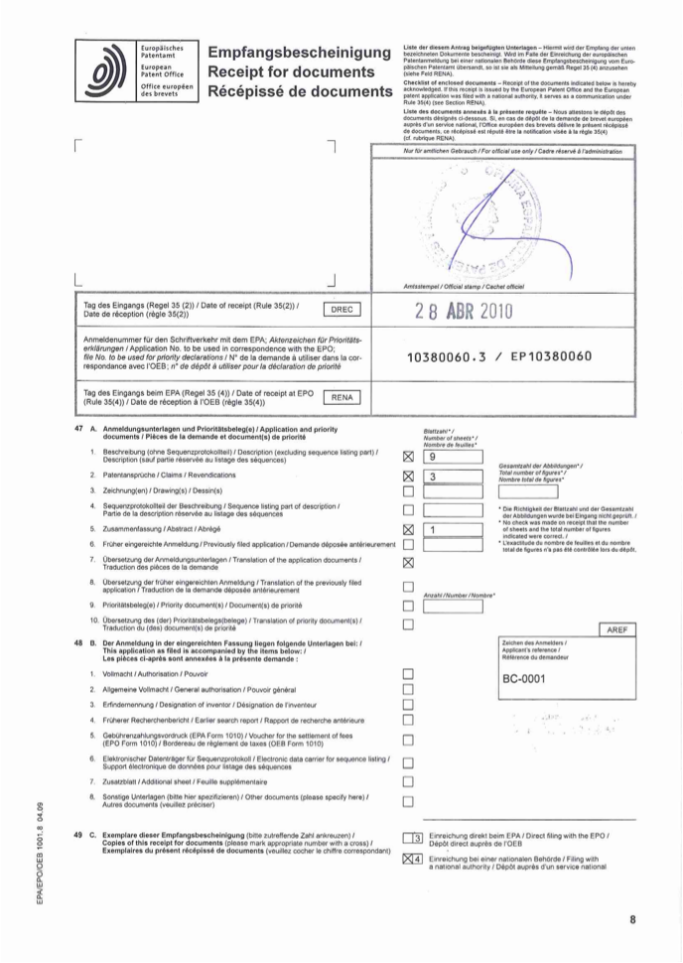
## FORTUNA KE

- Project: Optimal management of a half-marathon
- Goal: Develop mathematical models to optimize the flow of runners
- Interest for industry: Obtain simple guidelines to organize the starting line
- Interest for BCAM: Develop mathematical models and validate them in a real-life problem



## Patent Nro: 10380060.3

- Title: Method for selecting a transmission channel within a time division multiple access (TDMA) communication system
- Description: The invention refers to a method for selecting a transmission channel within a Time Division Multiple Access (TDMA) communications system, when several channels (each characterized by a variable and measurable quality of transmission parameter) are demanding to be active for a specific time slot
- Authors: Ayesta, U., Jacko, P.



Empfangsbescheinigung
Receipt for documents
Récépissé de documents

Amtsstempel / Official stamp / Cachet officiel

Tag des Eingangs (Regel 35 (2)) / Date of receipt (Rule 35(2)) / Date de réception (règle 35(2)) DREC: 28 ABR 2010

Anmeldenummer für den Schriftverkehr mit dem EPA; Aktenzeichen für Prioritätserklärungen / Application No. to be used in correspondence with the EPO; file No. to be used for priority declarations / N° de la demande à utiliser dans la correspondance avec l'OEB; n° de dépôt à utiliser pour la déclaration de priorité: 10380060.3 / EP10380060

Tag des Eingangs beim EPA (Regel 35 (4)) / Date of receipt at EPO (Rule 35(4)) / Date de réception à l'OEB (règle 35(4)) RENA

47 A. Anmeldungsunterlagen und Prioritätsbeleg(e) / Application and priority documents / Pièces de la demande et document(s) de priorité

| | | Blattzahl* / Number of sheets* / Nombre de feuilles* | Gesamtzahl der Abbildungen* / Total number of figures* / Nombre total de figures* |
|---|---|---|---|
| 1. Beschreibung (ohne Sequenzprotokollteil) / Description (excluding sequence listing part) / Description (sauf partie réservée au listage des séquences) | ☒ | 9 | |
| 2. Patentansprüche / Claims / Revendications | ☒ | 3 | |
| 3. Zeichnung(en) / Drawing(s) / Dessin(s) | ☐ | | |
| 4. Sequenzprotokollteil der Beschreibung / Sequence listing part of description / Partie de la description réservée au listage des séquences | ☐ | | |
| 5. Zusammenfassung / Abstract / Abrégé | ☒ | 1 | |
| 6. Früher eingereichte Anmeldung / Previously filed application / Demande déposée antérieurement | ☐ | | |
| 7. Übersetzung der Anmeldungsunterlagen / Translation of the application documents / Traduction des pièces de la demande | ☒ | | |
| 8. Übersetzung der früher eingereichten Anmeldung / Translation of the previously filed application / Traduction de la demande déposée antérieurement | ☐ | | |
| 9. Prioritätsbeleg(e) / Priority document(s) / Document(s) de priorité | ☐ | | |
| 10. Übersetzung des (der) Prioritätsbeleges(belege) / Translation of priority document(s) / Traduction du (des) document(s) de priorité | ☐ | | |

* Die Richtigkeit der Blattzahl und der Gesamtzahl der Abbildungen wurde bei Eingang nicht geprüft. / * No check was made on receipt that the number of sheets and the total number of figures indicated were correct. / * L'exactitude du nombre de feuilles et du nombre total de figures n'a pas été contrôlée lors du dépôt.

Anzahl / Number / Nombre*

AREF

Zeichen des Anmelders / Applicant's reference / Référence du demandeur: BC-0001

48 B. Der Anmeldung in der eingereichten Fassung liegen folgende Unterlagen bei: / This application as filed is accompanied by the items below: / Les pièces ci-après sont annexées à la présente demande :

| | |
|---|---|
| 1. Vollmacht / Authorisation / Pouvoir | ☐ |
| 2. Allgemeine Vollmacht / General authorisation / Pouvoir général | ☐ |
| 3. Erfindernennung / Designation of inventor / Désignation de l'inventeur | ☐ |
| 4. Früherer Recherchenbericht / Earlier search report / Rapport de recherche antérieure | ☐ |
| 5. Gebührenzahlungsvordruck (EPA Form 1010) / Voucher for the settlement of fees (EPO Form 1010) / Bordereau de règlement de taxes (OEB Form 1010) | ☐ |
| 6. Elektronischer Datenträger für Sequenzprotokoll / Electronic data carrier for sequence listing / Support électronique de données pour listage des séquences | ☐ |
| 7. Zusatzblatt / Additional sheet / Feuille supplémentaire | ☐ |
| 8. Sonstige Unterlagen (bitte hier spezifizieren) / Other documents (please specify here) / Autres documents (veuillez préciser) | ☐ |

49 C. Exemplare dieser Empfangsbescheinigung (bitte zutreffende Zahl ankreuzen) / Copies of this receipt for documents (please mark appropriate number with a cross) / Exemplaires du présent récépissé de documents (veuillez cocher le chiffre correspondant)

☐ 3 Einreichung direkt beim EPA / Direct filing with the EPO / Dépôt direct auprès de l'OEB

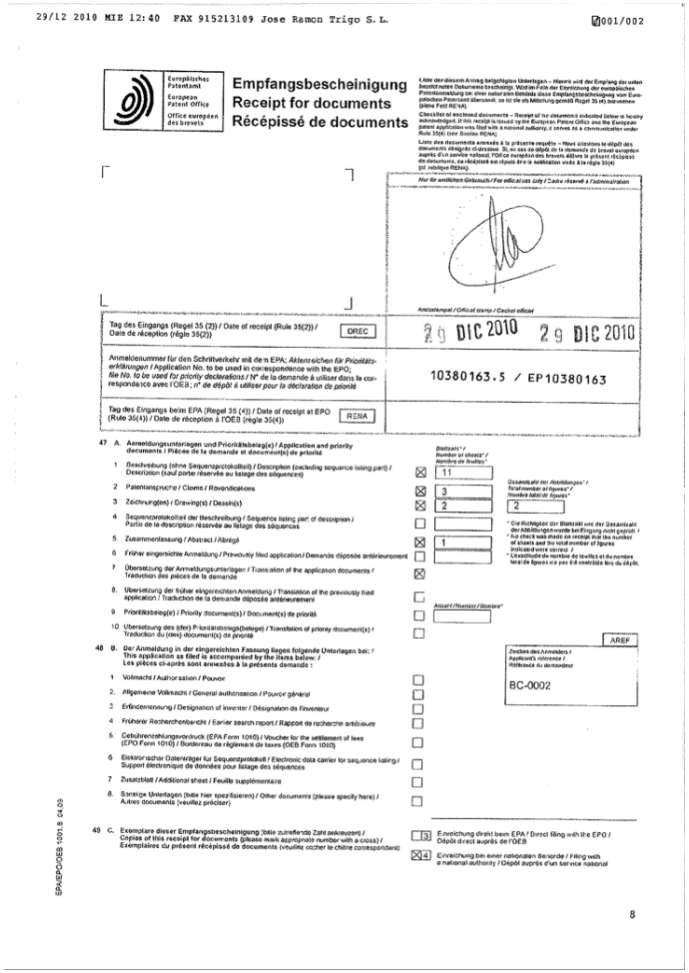
☒ 4 Einreichung bei einer nationalen Behörde / Filing with a national authority / Dépôt auprès d'un service national

EPA/EPO/OEB 1001.8 04.09

8

## Patent Nro: 10380163.5

- Title: Method for efficient scheduling in a resource-sharing system
- Description: The invention refers to a method in order to schedule the access to a processor resource on computer systems and data-processing systems. The invention can be applied in any resource-sharing system, whereby a resource-sharing is understood to be any system in which a resource is shared among multiple concurrent jobs. Examples of such systems are personal computers, server-farms, operating systems, etc.
- Authors: Ayesta, U., Verloop, M.



29/12 2010 MIE 12:40 FAX 915213109 Jose Ramon Trigo S.L. 001/002

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Récépissé de documents

Tag des Eingangs (Regel 35 (2)) / Date of receipt (Rule 35(2)) / Date de réception (règle 35(2)) — OREC — 29 DIC 2010 29 DIC 2010

Anmeldenummer für den Schriftverkehr mit dem EPA; Aktenzeichen für Prioritätserklärungen / Application No. to be used in correspondence with the EPO; No. to be used for priority declarations / N° de la demande à utiliser dans la correspondance avec l'OEB; n° de dépôt à utiliser pour la déclaration de priorité — 10380163.5 / EP10380163

Tag des Eingangs beim EPA (Regel 35 (4)) / Date of receipt at EPO (Rule 35(4)) / Date de réception à l'OEB (règle 35(4)) — RENA

47 A. Anmeldungsunterlagen und Prioritätsbeleg(e) / Application and priority documents / Pièces de la demande et document(s) de priorité

| | | Blattzahl / Number of sheets / Nombre de feuilles | Gesamtzahl der Abbildungen / Total number of figures / Nombre total de figures |
|---|---|---|---|
| 1 | Beschreibung (ohne Sequenzprotokollteil) / Description (excluding sequence listing part) / Description (sauf partie réservée au listage des séquences) | ☒ 11 | |
| 2 | Patentansprüche / Claims / Revendications | ☒ 3 | |
| 3 | Zeichnung(en) / Drawing(s) / Dessin(s) | ☒ 2 | 2 |
| 4 | Sequenzprotokollteil der Beschreibung / Sequence listing part of description / Partie de la description réservée au listage des séquences | ☐ | |
| 5 | Zusammenfassung / Abstract / Abrégé | ☒ 1 | |
| 6 | Früher eingereichte Anmeldung / Previously filed application / Demande déposée antérieurement | ☐ | |
| 7 | Übersetzung der Anmeldungsunterlagen / Translation of the application documents / Traduction des pièces de la demande | ☒ | |
| 8 | Übersetzung der früher eingereichten Anmeldung / Translation of the previously filed application / Traduction de la demande déposée antérieurement | ☐ | |
| 9 | Prioritätsbeleg(e) / Priority document(s) / Document(s) de priorité | ☐ | Anzahl / Number / Nombre |
| 10 | Übersetzung des (der) Prioritätsbeleg(e) / Translation of priority document(s) / Traduction du (des) document(s) de priorité | ☐ | |

AREF

48 B. Der Anmeldung in der eingereichten Fassung liegen folgende Unterlagen bei: / This application as filed is accompanied by the items below: / Les pièces ci-après sont annexées à la présente demande :

Zeichen des Anmelders / Applicant's reference / Référence du demandeur: BC-0002

| | | |
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| 1 | Vollmacht / Authorisation / Pouvoir | ☐ |
| 2 | Allgemeine Vollmacht / General authorisation / Pouvoir général | ☐ |
| 3 | Erfindernennung / Designation of inventor / Désignation de l'inventeur | ☐ |
| 4 | Früherer Recherchenbericht / Earlier search report / Rapport de recherche antérieure | ☐ |
| 5 | Gebührenzahlungsvordruck (EPA Form 1010) / Voucher for the settlement of fees (EPO Form 1010) / Bordereau de règlement de taxes (OEB Form 1010) | ☐ |
| 6 | Elektronischer Datenträger für Sequenzprotokoll / Electronic data carrier for sequence listing / Support électronique de données pour listage des séquences | ☐ |
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EPA/EPO/OEB 1001.5 04.05

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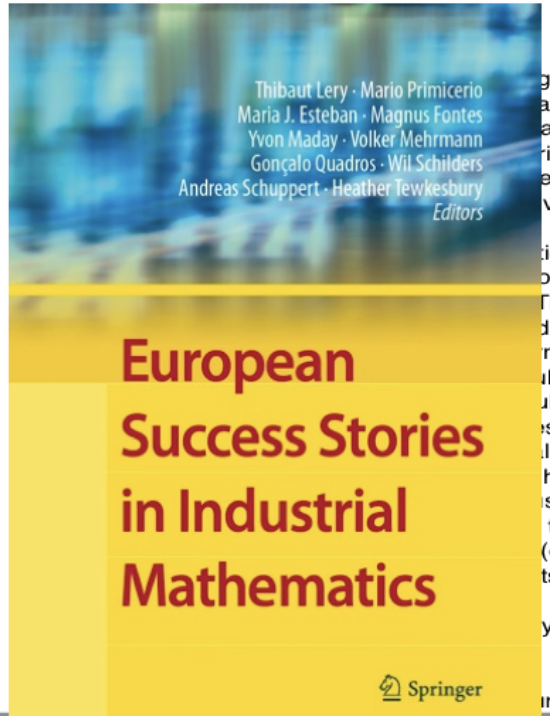
# Dynamical modelling of morphology development in multiphase latex particles

## Executive summary

In this project a dynamic model was designed to predict the development of the morphology of multiphase waterborne systems, such as polymer-polymer and polymer-polymer-inorganic hybrids.

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basque center for applied mathematics
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New analytical and numerical methods in wave propagation
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Publications
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Welcome to the New analytical and numerical methods in wave propagation project website.
Project acronym: NUMERIWAVES financed by European Research Council – ERC
Project Acronym: NUMERIWAVES
Project full title: New analytical and numerical methods in wave propagation
Grant Agreement no.: FP7 - 246775
Principal Investigator: Enrique Zuazua
Host Institution: BCAM - Basque Center for Applied Mathematics
From: February, 1st 2010 To: January, 31st 2015
IDEAS
Terminado


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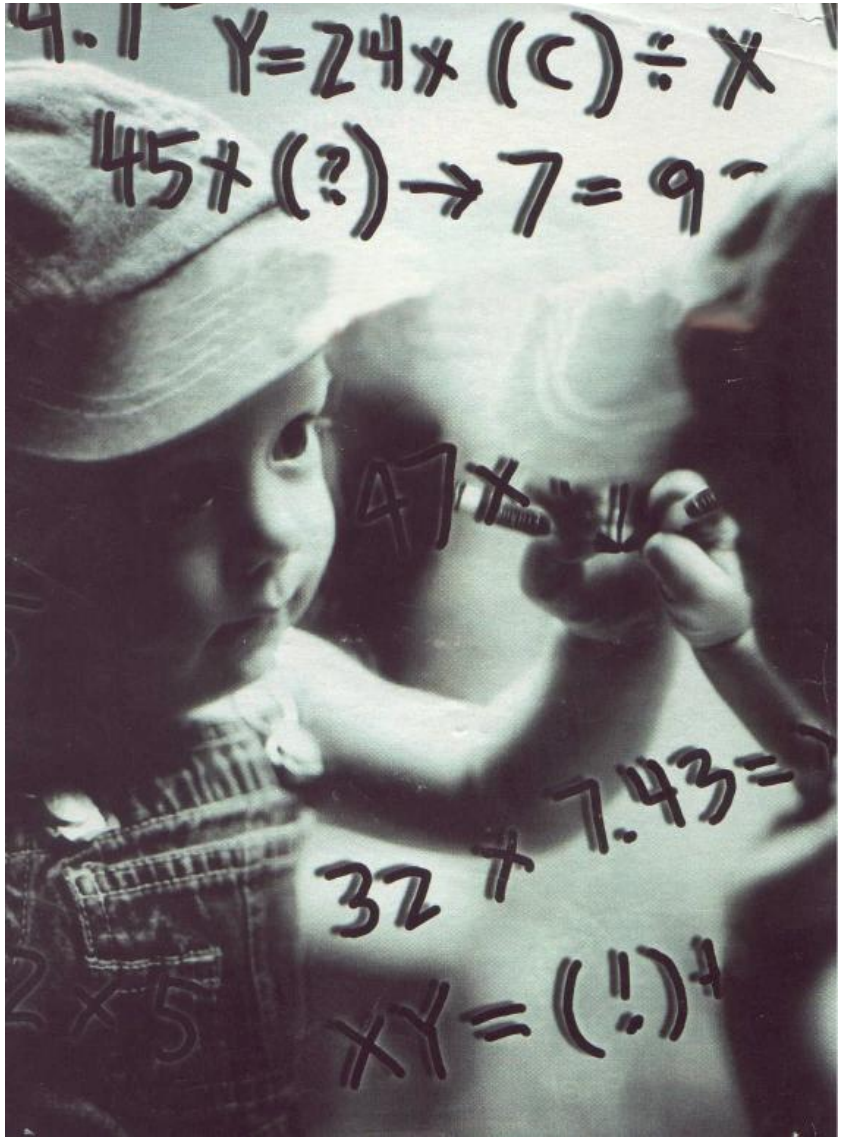
9 10

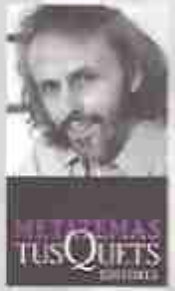

9.1 Y=24x (C) ÷ X
45x (?) → 7 = 9
47x
32 + 7.43 =
2x5
XY = (!!)

John Allen Paulos

# EL HOMBRE ANUMÉRICO

El analfabetismo matemático y sus consecuencias

«Inteligente análisis de las locuras que engendra la falta de comprensión de la ciencia y de las matemáticas.»
Isaac Asimov



METATEMAS
TUSQUETS EDITORES

basque center for applied mathematics

Universidad del País Vasco — Euskal Herriko Unibertsitatea

# Basque Colloquium in Mathematics and its Applications

**11:30** Jean-Baptiste HIRIART-URRUTY, University Paul Sabatier, Toulouse, France

THE $\epsilon$-STRATEGY IN VARIATIONAL ANALYSIS

**In this work we discuss variational (or optimization) problems which do not have solutions necessarily, but which do have approximate solutions (or solutions within $\epsilon > 0$). The question we address is: what to do with such $\epsilon$-solutions? We shall see how to recover all the minimizers of the relaxed version of an abstract variational problem in terms of $\epsilon$-minimizers of the original variational problem (specially when the later has no solution).**
**Applications to two classes of approximation problems in a Hilbert space setting will be shown.**

**12:30** Björn BIRNIR, University of California, Santa Barbara, CA, USA

EXISTENCE, UNIQUENESS AND STATISTICAL THEORY OF THE STOCHASTIC NAVIER-STOKES EQUATION IN THREE DIMENSIONS

**We will discuss the existence of unique rough solution of the Navier-Stokes equation in three dimensions. These solutions are the result of noise that the equation produces at high Reynolds numbers. They also give a unique invariant measure that permits the development of Kolmogorov's statistical theory of turbulence.**

**13:45** Lunch and informal discussion

**October 9, 2009**
**Room 0.24, Faculty of Science and Technology, UPV/EHU (LEIOA campus)**

**Organizers and contacts:**

BCAM-Basque Center for Applied Mathematics
Bizkaia Technology Park, Building 500 Derio - Basque Country- Spain http://www.bcamath.org
(roldan@bcamath.org)

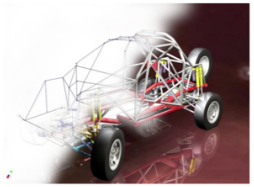
Mathematical Analysis and Applications, Mathematics Section, Faculty of Science and Technology
UPV/EHU (LEIOA campus) Box 644 Bilbao 48080. http://www.ehu.es/amaplicado
(miguel.escobedo@ehu.es)

February, 26th 2010


November 26th 2010


November 17th 2011

Maths for automotive Industry

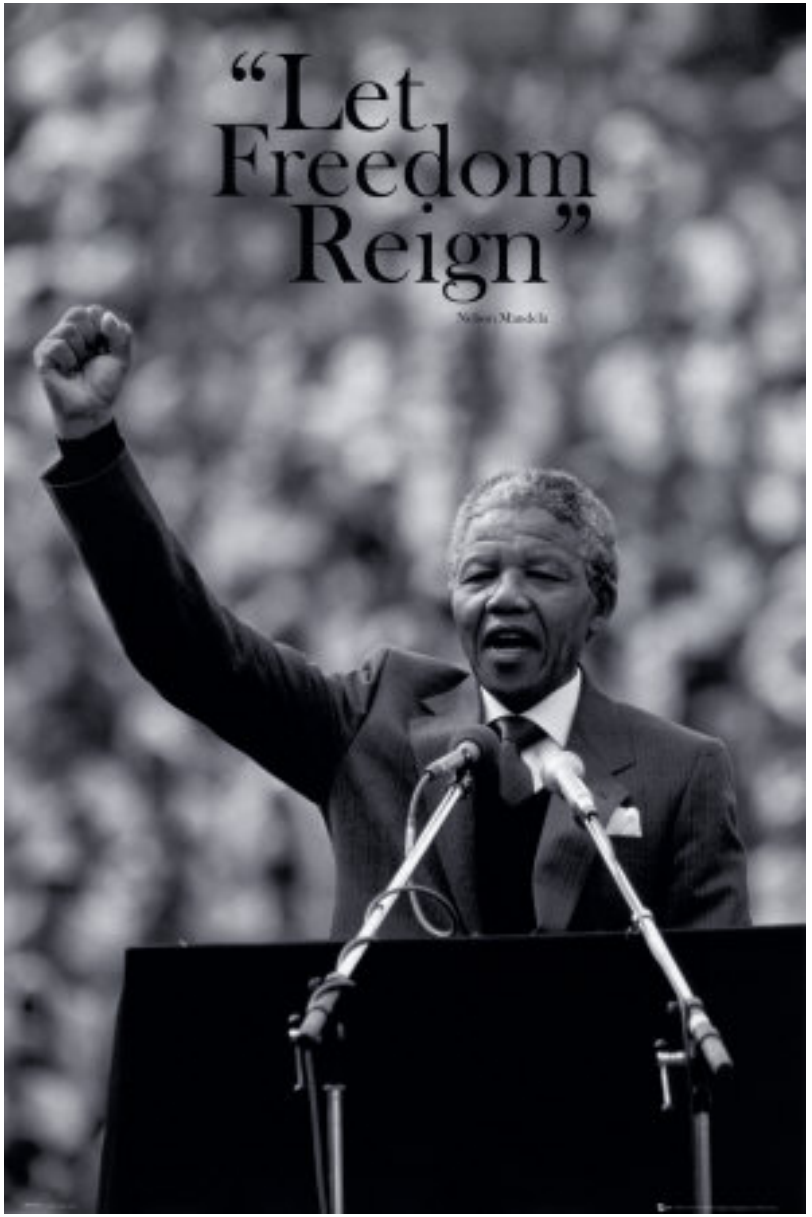


bcam basque center for applied mathematics

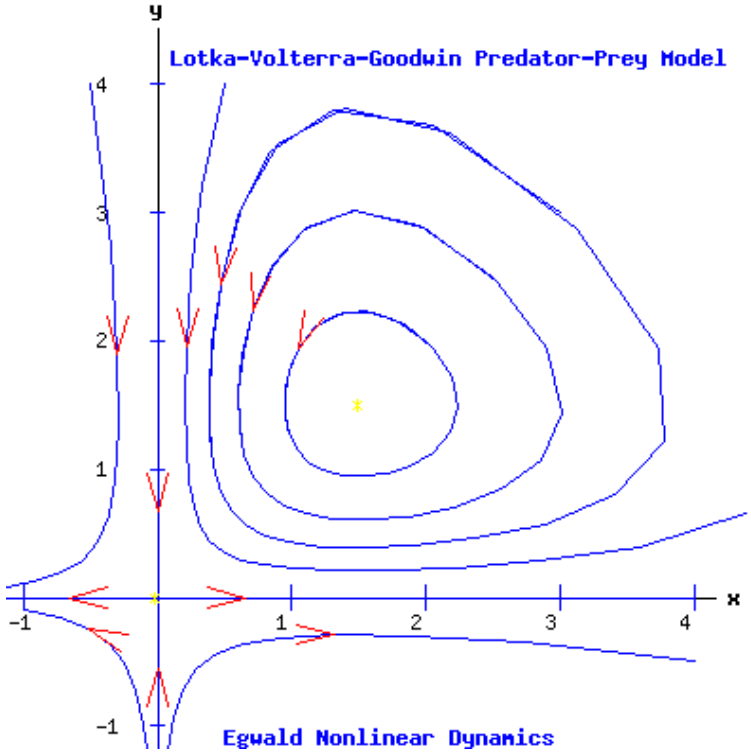
aic AUTOMOTIVE INTELLIGENCE CENTER

bizkaia :::xede

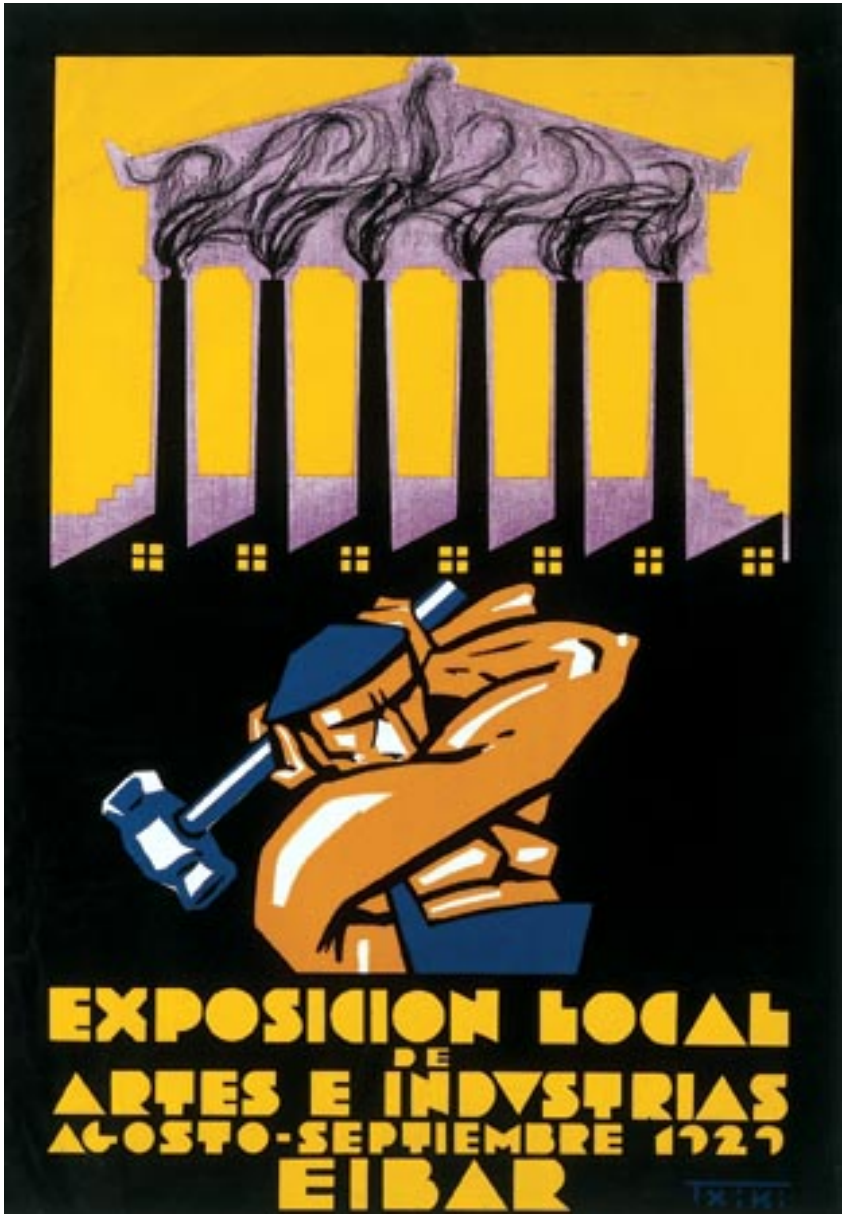
BFA DFB Bizkaiko Foru Aldundia Diputación Foral de Bizkaia


"Let Freedom Reign"
Nelson Mandela

Dos idiomas. ¿Un abismo?




Las ecuaciones de Lotka-Volterra, o de predador-presa propuestas de forma independiente por Alfred J. Lotka en 1925 y Vito Volterra en 1926.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AGOSTO-SEPTIEMBRE 1929
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# Su futuro en tus manos

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|---|---|---|---|---|
| 1 | **Massachusetts Institute of Technology** | mit.edu | us | North America |
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| 3 | **Stanford University** | stanford.edu | us | North America |
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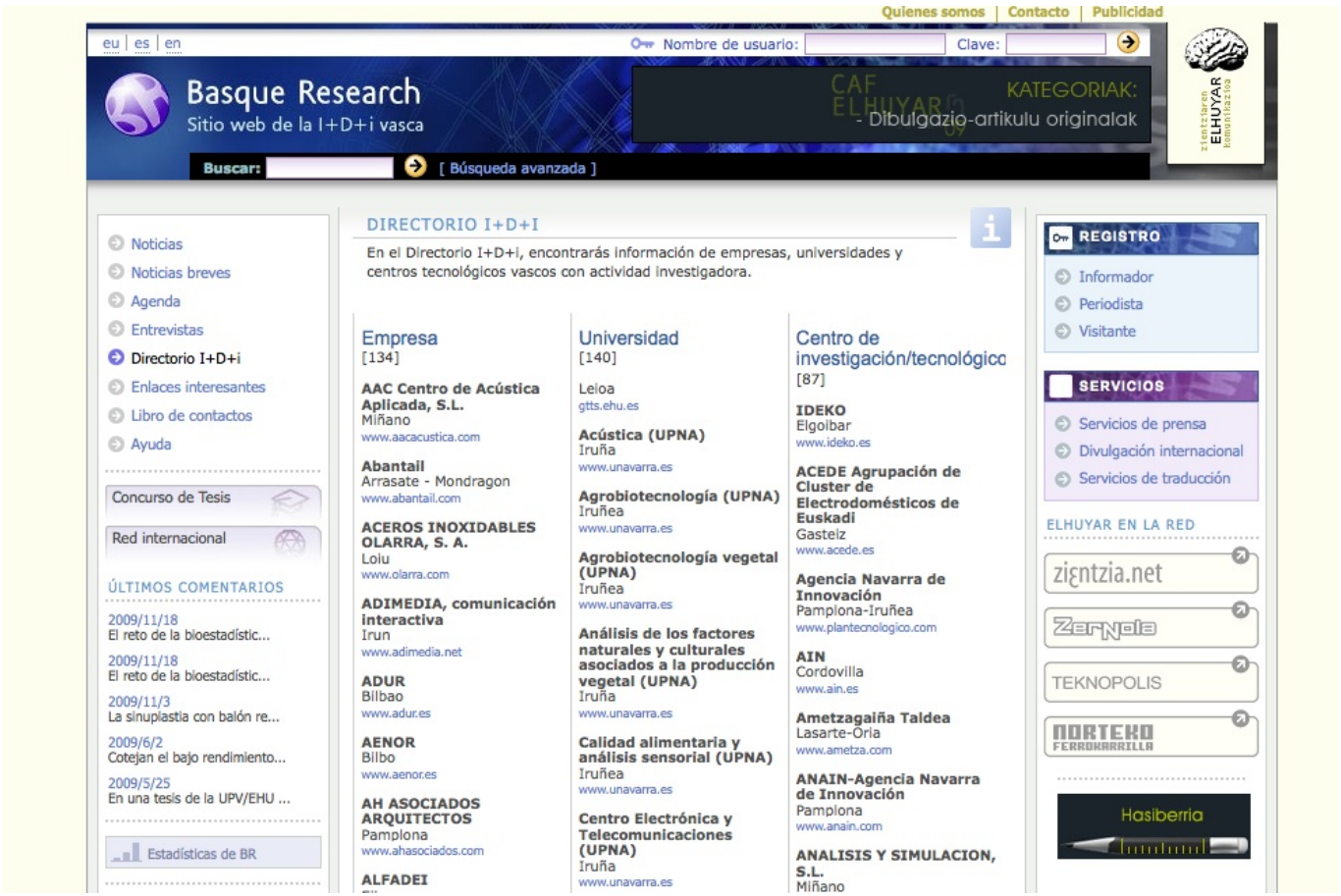
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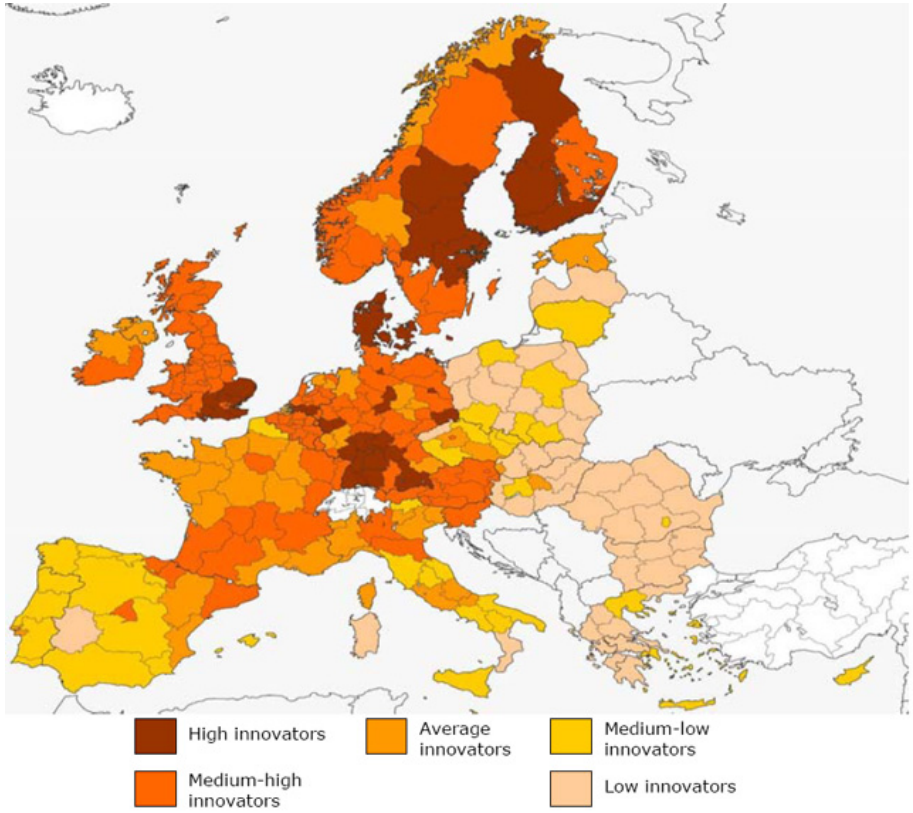
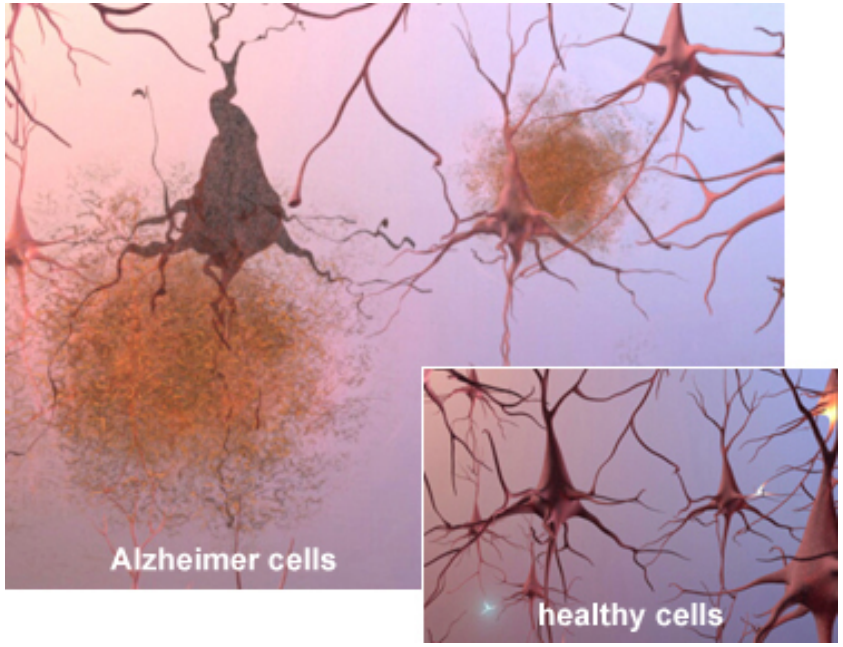


Nazioarteko erronka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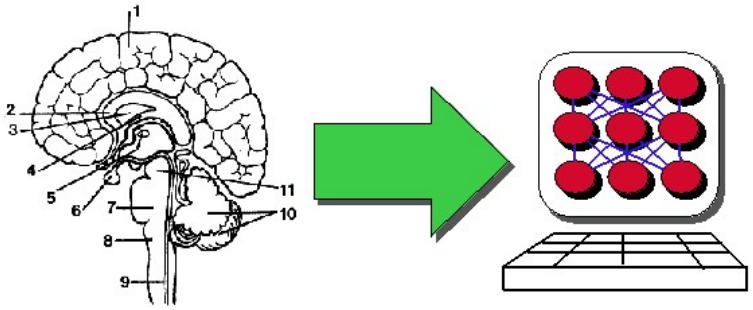
healthy cells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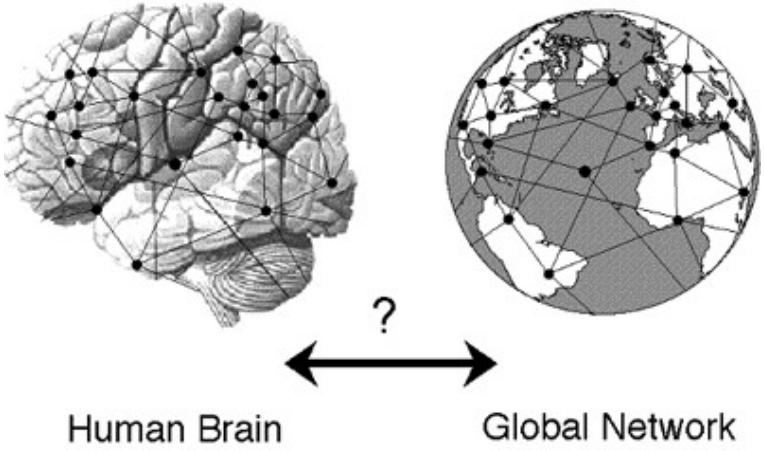

?
Human Brain
Global Network

1.- Multilingüismo real.

2.- Sistema integral de educación.

3.- Ambición, visión y acción internacional y a largo plazo.

4.- Concentrar apuestas.

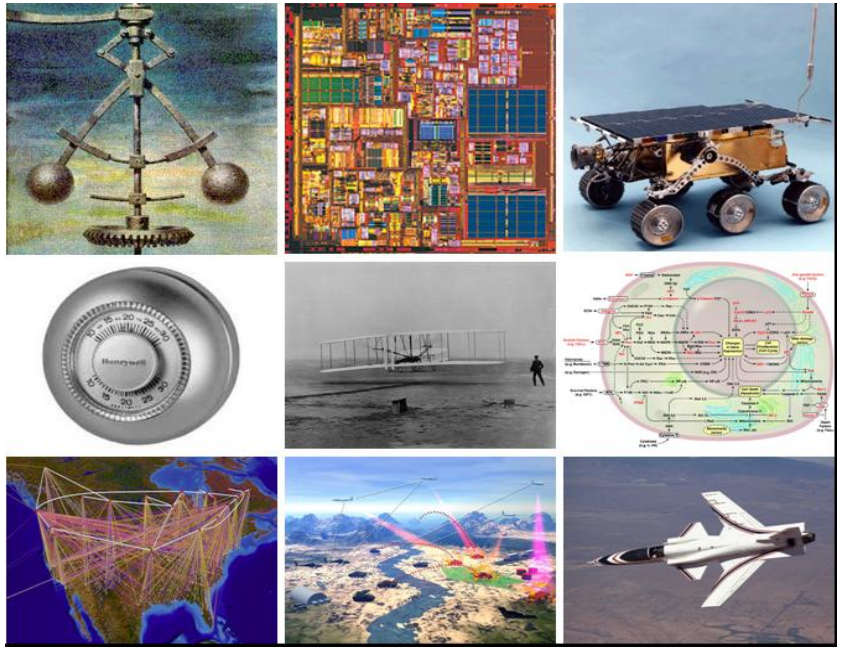
5.- Ser abiertos y ágiles.

6.- Más coordinación en la red vasca de I+D+i.

7.- Autocrítica y autoevaluación.

# 9.- Etorkizunera begira

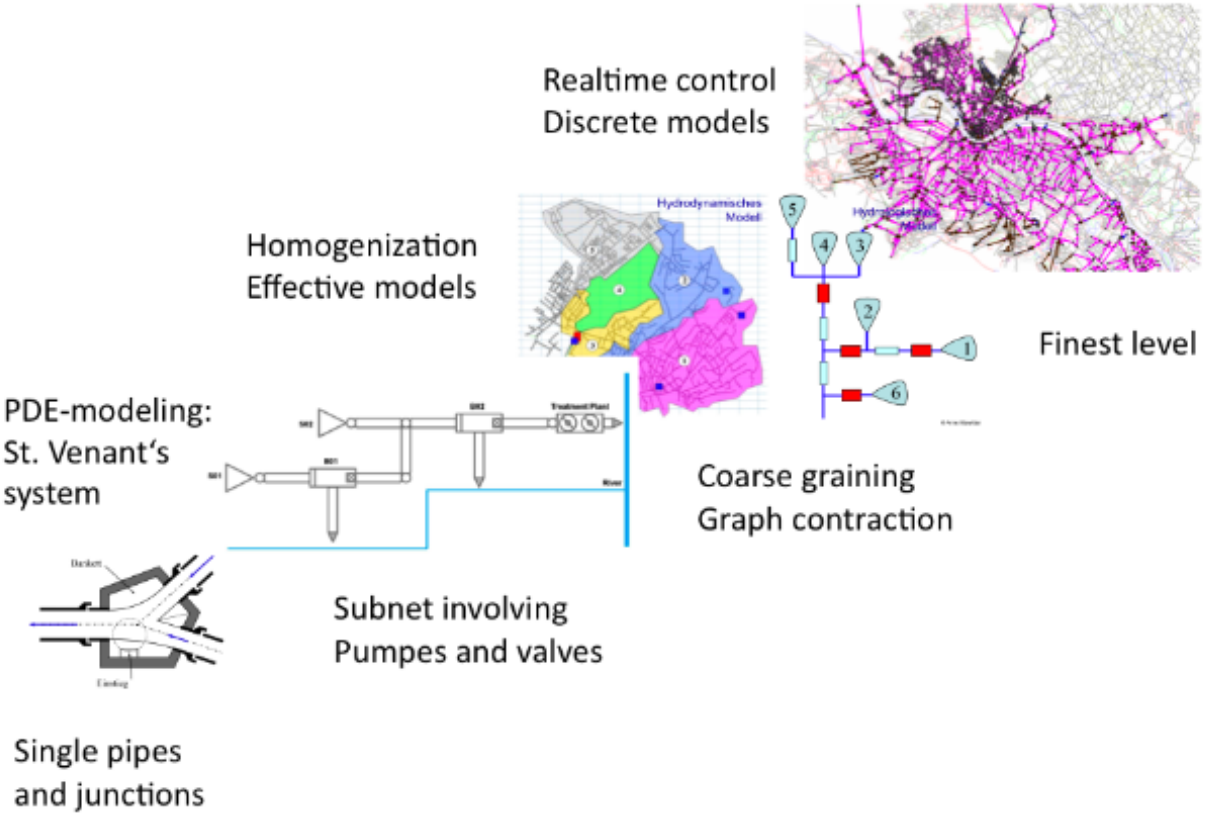
# 9.- Perspectivas



*Control in an information rich World, SIAM, R. Murray Ed., 2003.*

Eta beste asko....

# Robotika.

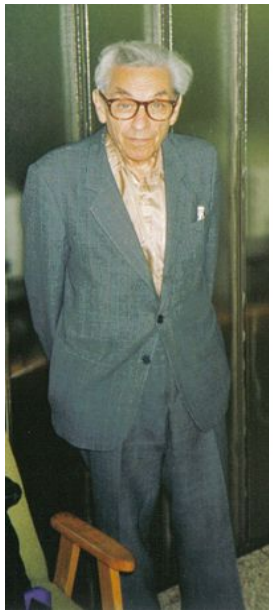

Eskala anitzak = Matematika anitzak

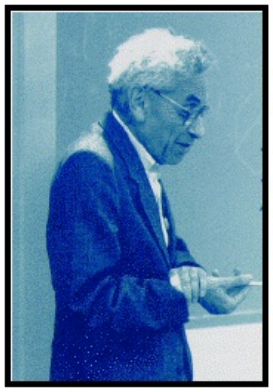
Las matemáticas se verán influenciadas por la creciente tendencia a la complejidad y a la multidisciplinaridad. Aumentará así la importancia deáreas de las matemáticas como:

- La matemática discreta y los grafos;
- La minería de datos;

y otros campos de investigación como las neurociencias y las ciencias sociales.

# Matemático = Máquina de transformar café en Teoremas





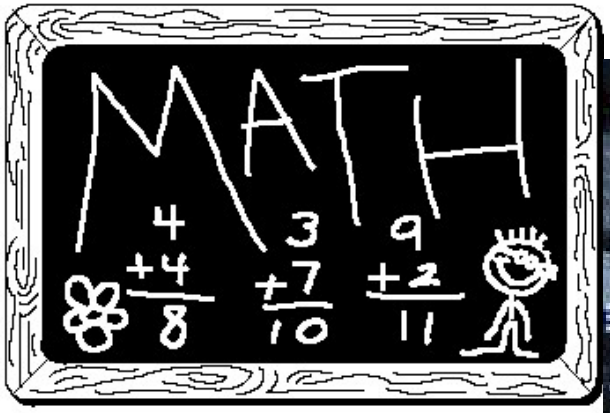
**The Erdös Number Project**

**This is the website for the Erdös Number Project, which studies research collaboration among mathematicians.**

*The site is maintained by **Jerry Grossman** at **Oakland University**. **Patrick Ion**, a retired editor at **Mathematical Reviews**, and **Rodrigo De Castro** at the **Universidad Nacional de Colombia, Bogota** provided assistance in the past. Please address all comments, additions, and corrections to Jerry at **grossman@oakland.edu**.*

**Erdös numbers** have been a part of the **folklore of mathematicians** throughout the world for many years. For an introduction to our project, a description of what Erdös numbers are, what they can be used for, who cares, and so on, choose the "What's It All About?" link below. To find out who **Paul Erdös** is, look at this **biography** at the MacTutor History of Mathematics Archive, or choose the "Information about Paul Erdös" link below. Some useful information can also be found in **this Wikipedia article**, which may or may not be totally accurate.

Paul Erdös (1913–1996)


MATH
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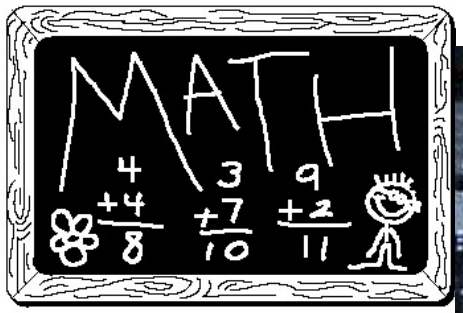
ETA ETORKIZUNEAN?




*El genio es un uno por ciento de inspiración, y un noventa y nueve por ciento de transpiración.*

Thomas Alva Edison (1847–1931)

*Not everything that can be counted counts, and not everything that counts can be counted.*

Albert Einstein (1879–1955)

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*Ezagutzen duguna ur tanta da. Ezagutzen ez duguna, ordea, ozeanoa....*

*Lo que sabemos es una gota de agua; lo que ignoramos es el océano....*

Isaac Newton