Visit of INRIA Rhône-Alpes

Group of participants of FSR'07

July 9, 2007

Visit of INRIA Rhône-Alpes

11:30   Bus arriving at INRIA – Welcome by *Marie Collin*

INRIA Auditorium

11:30 – 11:45 Welcome address & Presentation of INRIA Rhône-Alpes
Alain Viari, President of the Scientific Committee of INRIA Rhône-Alpes

11:45 – 11:55   Visit program & Few words about Robotics at INRIA RA
Christian Laugier, Scientific Leader of the "e-Motion" team-project
FSR'07 General Chair

11:55 – 12:10 Presentation of the "Grimage" platform
Radu Horaud, Scientific Leader of the "Perception" team-project

INRIA Experimental Platforms

12:10 – 14: 15 Visiting the experimental platforms in the field of Robotics,
Vision, and Virtual Reality (6 demos & 4 Sub-Groups G1, G2, G3, G4)

13:15 – 14:30 Quick Lunch (G3+G4 then G1+G2)

14:30 - Bus departure for Chamonix

Welcome address
&
Presentation of INRIA Rhône-Alpes

Alain Viari

President of the Scientific Committee of INRIA Rhône-Alpes

INRIA
RHÔNE-ALPES

# Few words about Robotics at INRIA RA
The "e-Motion" Team-Project
"Geometry and Probability for Motion and Action"
Scientific Leader: Christian Laugier

• **Scientific challenge :** *To develop « artificial systems » having sensing, decisional, and acting capabilities efficient & robust enough for making them really operational in open (i.e. large & weakly structured) and dynamic environments.*

• **Main applications domains :**

Intelligent Vehicles, Service Robots
Mobile Robots...
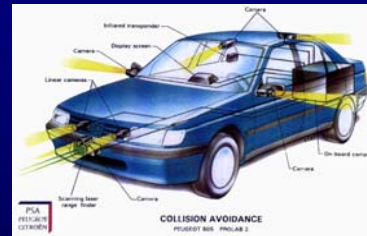
• **Focus on three main issues:**

– **Motion & Action Autonomy in a complex dynamic world**

=> *Incremental world modeling, Time-space dimension, Estimation & Prediction of world states*

– **Increased Robustness & Safety of Navigation systems (perception & control)**
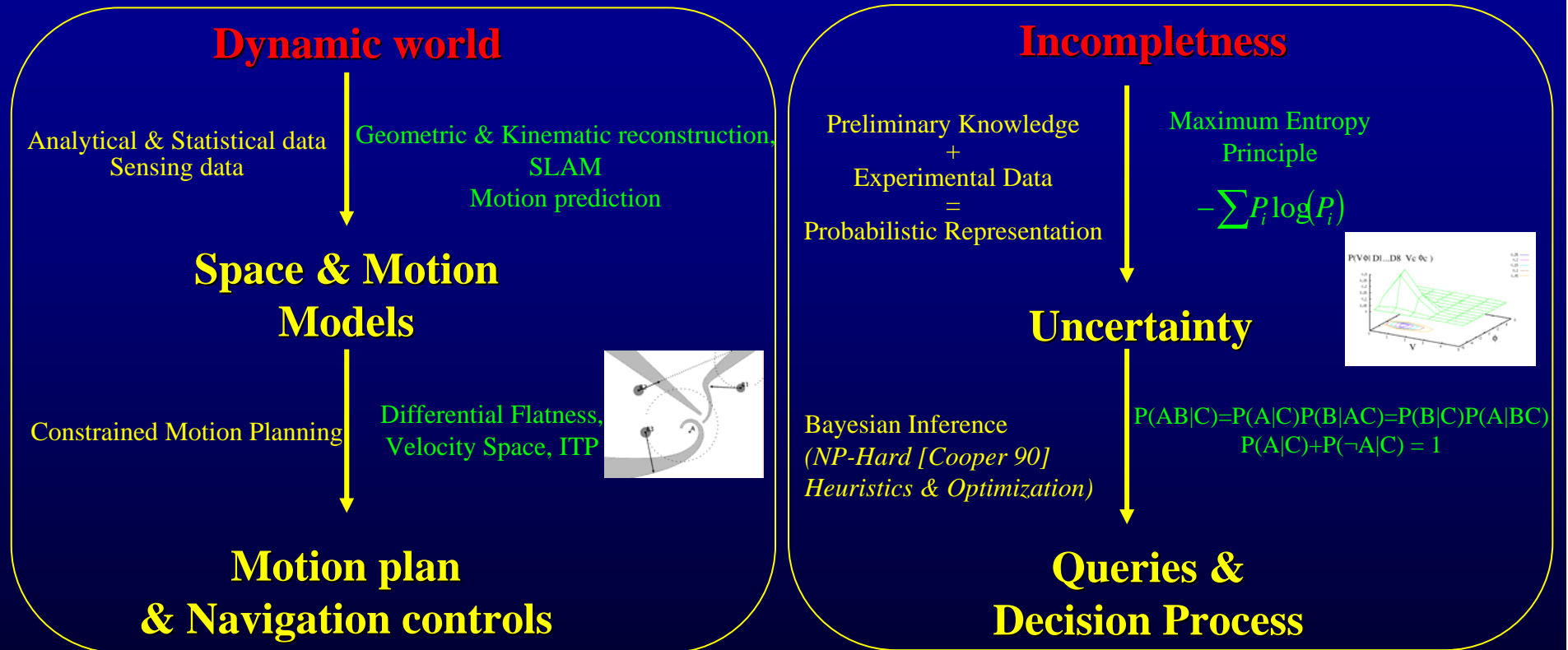
=> *Reasoning about Incompleteness & Uncertainty (Probabilistic approaches)*

– **Efficient & Adaptive Sensory-motor behaviors**

=> *Bayesian programming & Self learning capabilities*

INRIA RHÔNE-ALPES

Two complementary reasoning processes

There are evidences that biological systems make use of several functional processes and representations (e.g. Topo-kinetic memory for planning & Topo-kinesthesic memory for navigation, cf. A. Berthoz)
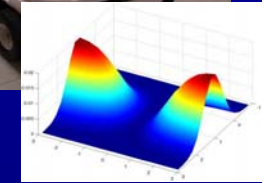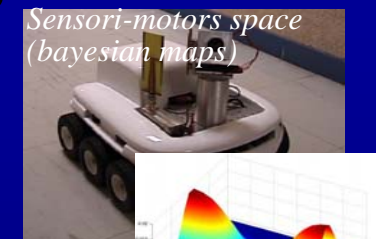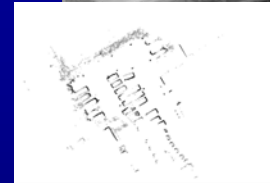
Dynamic world

Analytical & Statistical data
Sensing data

Geometric & Kinematic reconstruction, SLAM
Motion prediction

Space & Motion Models

Constrained Motion Planning

Differential Flatness, Velocity Space, ITP

Motion plan & Navigation controls

Mastering the complexity by using the right reasoning level & incremental approaches

Incompletness

Preliminary Knowledge
+
Experimental Data
=
Probabilistic Representation

Maximum Entropy Principle

$$-\sum P_i \log(P_i)$$

P(V θ | D1...D8 Vc θc)

Uncertainty

Bayesian Inference
*(NP-Hard [Cooper 90]
Heuristics & Optimization)*

$P(AB|C)=P(A|C)P(B|AC)=P(B|C)P(A|BC)$
$P(A|C)+P(\neg A|C) = 1$

Queries & Decision Process

Taking explicitly into account the hidden variables & uncertainty at the reasoning level

Research axes

- **Perception & Multi-modal Modeling of "Space & Motion"**
  - *Incremental world modeling*
  - *Estimation & Prediction of world states*
  - *Sensory-motors maps*

Dynamic SLAM

*Sensori-motors space (bayesian maps)*

- **Motion planning in a dynamic world**
  - *Partial Motion Planning paradigm (PMP)*
  - *Instantaneous escaping trajectories (Velocity space)*
  - *Inevitable collision states (State-time space)*

NH constraints

Space-Time constraints
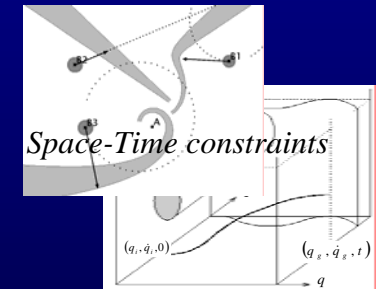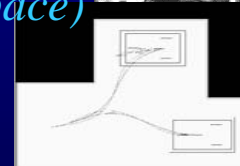
- **Bayesian inference for Decision and Safe Navigation**
  - *Bayesian programming models and tools*
  - *Automatic learning*
  - *Modeling biological sensory-motor mechanisms*

Sensory data fusion (situation analysis)

Learning reactive behaviors
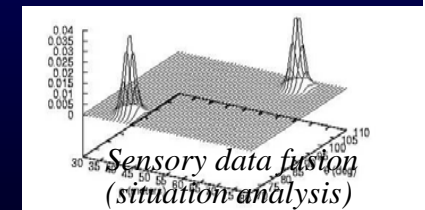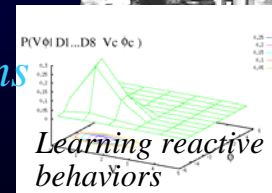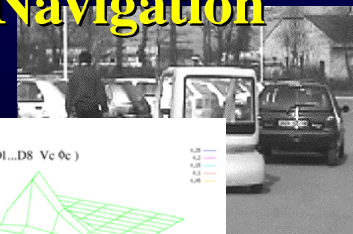
INRIA
RHÔNE-ALPES

Team-Project members

- **Permanent staff** *(6 + 2)*
  - 1 Scientific leader : Christian Laugier, DR2 Inria
  - 3 INRIA Researchers : Thierry Fraichard, Agostino Martinelli, Sepanta Sekhavat *(currently in Iran)*
  - 2 CNRS Researchers : Pierre Bessiere, Emmanuel Mazer *(currently in our start-up « Probayes »)*
  - 2 Associate Professors : Olivier Aycard (UJF), Anne Spalanzani (UPMF)

- **Invited researchers, Postdocs, and Engineers** *(average of 4)*

- **PhD students** *(average of 8)*
  - *=> An average of 2 PhD theses defenses each year*

INRIA
RHÔNE-ALPES

International Cooperation

- **Outside Europe**
  - Research Agreements with Riken (Japan), University of Singapore (NTU & NUS)
  - Coordinator of the Research Network on ITS (ICT-Asia "FACT") with Japan, Korea, Singapore, China, and France
  - Coordinator of the France-Mexico Image & Robotics network

- **European projects**
  - *NoE « Euron »*
  - *IST "Cybercars", "Prevent", "Cybercars2"*
  - *IST-FET "Biba" & IP "Bacs" (Bayesian Approach to Cognitive Systems)*

INRIA
RHÔNE-ALPES

Industrial Cooperation

- **National projects involving Industrial companies**
  - *Predit (Arcos, MobiVip, Puvame)*
  - *ANR (LoVe)*

- **Start-ups**

  ITMI, Getris Images, Aleph Technologies, Aleph Med, Probayes (2003)

- **Industrial contracts & Valorization**
  - *Probayes*
  - *Toyota Europe, Denso Japan, Hitachi Japan*

INRIA
RHÔNE-ALPES

Robotics Experimental Platform
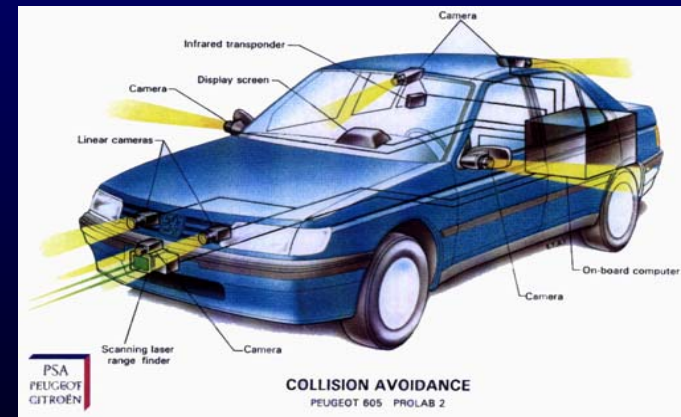

Parkview

Commercialized by Robosoft

Cycab & Simulator

Koala

Commercialized by Bluebotics

Autonomous Wheelchairs

Industrial Experimental Vehicles

INRIA
RHÔNE-ALPES

Main Research Topics & Results

Pedestrian

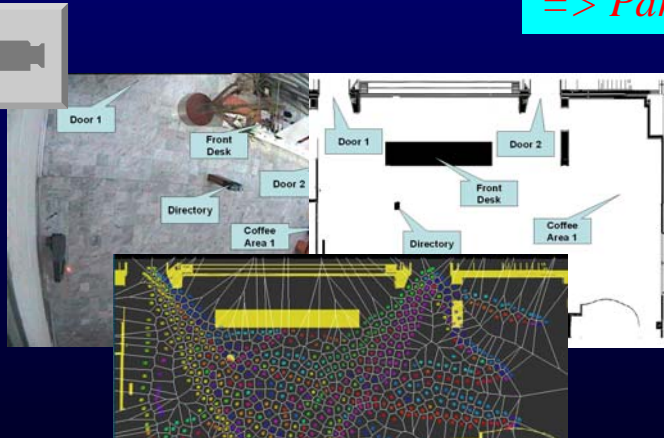Toyota

Autonomous Navigation
=> SLAM + MP + Reactive Behaviors

World state Estimation & Prediction
=> Bayesian Occupancy Filter

NH Safe Motion Planning in a Dynamic Env
=> Partial Motion Planning & Inevitable Collision State

Static
Obstacle

Obstacle

Collision States

Moving
Obstacle

ICS

ICS-free
trajectory

Moving
Obstacle

Door 1

Front
Desk

Door 2

Directory

Coffee
Area 1

Door 1

Door 2

Front
Desk

Directory

Coffee
Area 1

Motion & Behavior Prediction
=> Learn & Predict paradigm (GHMM)
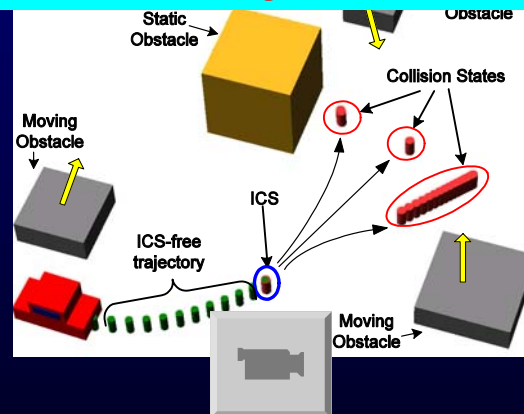
Autonomous Wheelchair
=> Brain Control & Learned Behaviors

INRIA
RHÔNE-ALPES

Program of the Visit

INRIA Auditorium

    11:55 – 12:10 Presentation of the "Grimage" platform

        Radu Horaud, Scientific Leader of the "Perception" team-project

INRIA Experimental Platforms

    12:10 – 14: 15 Visiting the experimental platforms in the field of Robotics,

        Vision, and Virtual Reality (6 demos & 4 sub-groups)

        Group G1 conducted by Agostino Martinelli

        Group G2 conducted by Christian Laugier

        Group G3 conducted by Marie Collin

        Group G4 conducted by Jean-Marc Hasenfratz

    13:15 – 14:30 Quick Lunch (G3+G4 then G1+G2)

    14:30 - Bus departure for Chamonix

INRIA
RHÔNE-ALPES

Presentation of the "Grimage" Platform

Radu Horaud
Scientific Leader of the "Perception" Team-Project

Name	Given Name	Company	Country	Group
BARFOOT	Tim	University of Toronto	Canada	G1
BATALIN	Maxim	University of California	U.S.A	G1
BUALAT	Maria	NASA	U.S.A	G1
DUKE	David	Carnegie Mellon University	U.S.A	G1
ECK	Daniel	University of WŸrzburg	Germany	G1
FISCHER	Wolfgang	ASL-ETH ZŸrich	Switzerland	G1
FAIRFIELD	Nathaniel	Robotics Institute	U.S.A	G2
GREEN	Colin	Carnegie Mellon University	U.S.A	G2
HOWARD	Thomas	Carnegie Mellon University	U.S.A	G2
JOYEUX	Sylvain	LAAS/CNRS	France	G2
JUTILA	Jaakko	Helsinki University of Technology (TKK)	Finland	G2
KALANTAR	Shahab	Australian National University	AUSTRALIA	G2
KELLY	Alonzo	National Robotics Eng. Center	U.S.A	G3
KHAN	Mohammad Aamir	DIMEC	Italy	G3
MULLIGAN	Jane	University of Colorado	U.S.A	G3
ROMAN	Matthew	University of Oklahoma	U.S.A	G3
ROSS	Bill	Carnegie Mellon University	U.S.A	G3
SHOUDONG	Huang	University of Technology	AUSTRIA	G4
SINGH	Amarjeet	University of California	U.S.A	G4
SINGH	Sanjiv	Carnegie Mellon University	U.S.A	G4
VISALA	Arto	Helsinki University of Technology	Finland	G4
WANG	Shuo	Lab. of Complex Systems	P.R. China	G4

Detail of the Visit & Demos

D1: Autonomous Vehicle (Cycab)
    Mehdi Rabah & Thierry Fraichard *(e-Motion team-project)*
D2: Advanced Driving Assistance Systems
    Vu Trung Dung & Christopher Tay *(e-Motion team-project)*
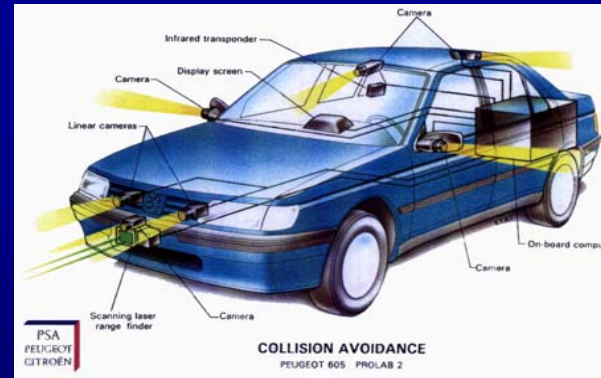D3: Artificial Walking
    Bernard Espiau & Roger Pissard-Gibollet *(Bipop team-project)*
D4: Artificial Vision – Mattijs Douze *(Lear team-project)*
D5: Virtual Reality & Haptic Interaction – Sabine Cocquillart *(I3D team)*
D6: Intelligent office – Jim Crowley & Matthieu Langet *(Prima team-project)*

	D1 Robotics Platform	D2 Robotics Platform	D3 Robotics Platform	D4 Robotics Platform	D5 Workbench Platform	D6 Smart Office Platform	Lunch
12:15 – 12:30	G1	G2	G3				
12:30 – 12:45	G2	G3	G1				
12:45 – 13:00	G3	G1	G2				
13:00 – 13:15				G1	G2	G3	
13:15 – 13:30				G2	G3	G1	
13:30 – 13:45				G3	G1	G2	
13:45 – 14:00							
14:00 – 14:15							

INRIA
RHÔNE-ALPES

Thank You !
Any questions ?

http://emotion.inrialpes.fr/laugier
christian.laugier@inrialpes.fr

INRIA
RHÔNE-ALPES