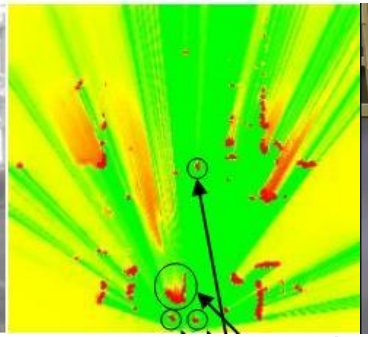
INSA INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

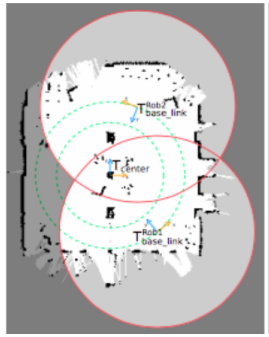
citi lab

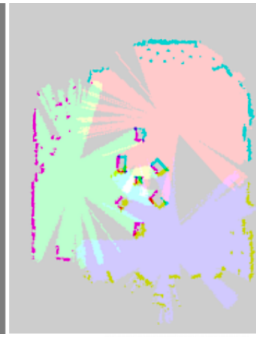
informatiques mathématiques Inria

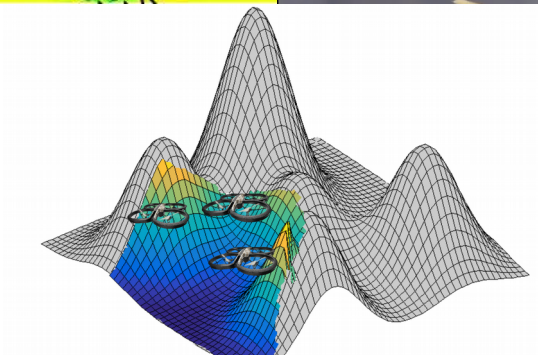
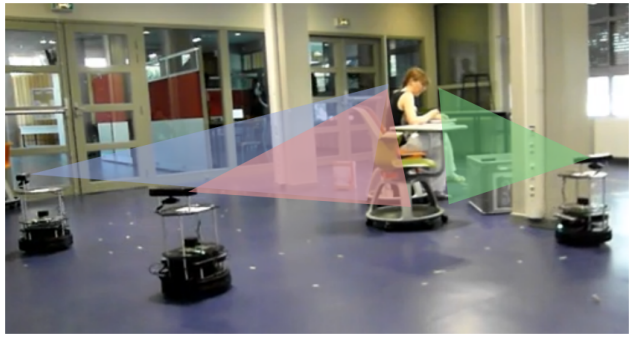
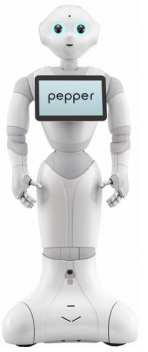
Robotique au CITI et au Dept. TC

Olivier Simonin





CITI lab.

Wireless networks, IoT, Cognitive radio, Middleware, Dist. Robotics

Equipes concernées par la robotique :

Chroma (INRIA) : Navigation autonome et coopération multi-robot

- Perception pour la navigation autonome
- Prise de décision distribuée vs. centralisée multi-robot
- Navigation sociale en environnent dynamique (foules)

Agora (INRIA) : Communication sans fil dans les réseaux de capteurs et robots

- Protocoles de communication dans les flottes de drones/robots
  - H. Rivano, co-enc. thèse avec Chroma (loc. basée UWB)
  - F. Valois, co-enc. thèse avec Chroma

Dynamid : Logiciel (middleware) pour systèmes distribués

- Middleware pour les systèmes multi-robots
  - J. Ponge, co-enc. thèse avec Chroma (S. Chitic, 2013-18)

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- 1 Prof, 1 MCF (O. Simonin, J. Dibangoye)
- + 2 associés CPE (20%) et 1 MCF HDR délégation INRIA (J. Sarayadryan, F. Jumel, C. Wolf)
- 1 Ingénieur expert INRIA, V. Ledoze (2018-2019) → Contrôle / Drones
- 1 IR INSA 50% en thèse Agora & Chroma, S. d'Alu → Communication dans flottes / UWB.

Plateformes

CITI et TC

CITI & TC :

1 Pepper

15 robots mobiles Turtlebot 2 (avec Kinect) dont 5 avec LIDAR

4 drones Parrot Bebop

+ CITI

5 mini drones Crazyflies

2 drones Intel Aero

...

Les Projets (CITI-Chroma)

en cours

Projets

Vehicles :

- **European project H2020** "ENABLE" (2016-19) avec Inria Grenoble : Perception et Navigation
- **Chaire VOLVO** : 1 Doc. et 1 post-doc Optimisation tournées véhicules autonomes (VRP)

Navigation sociale :

- **ANR Hianic** (2017-20) portée par A. Spalanzani (Grenoble) : 1 PHD avec CITI
- **Regional project** TENSIVE : **PhD** with GIPSA : robot de téléprésence (Awabot)
- **RoboCup** @ **Home** : qualification Finale league Pepper (Juin 18), 6K€ INSA. (Hoomano)

Coopération multi-robots

- **Regional project** : 1 PhD (2016-19), O. Simonin
- **PHC** bi-lateral franco-roumain '**DRONEM**' (2017-19) 14K€, O. Simonin

Drones

- INRIA **ADT 'CORDES'** (2017-18) : Cartographie 3D, O. Simonin
- INRIA-DGA **PhD** (2017-20) with LIP/Inria DANTE : mobilité contrôlés (communication)
- **ANR** (INSA) Connect-IO (N. Stouls)
  - SPOC(MOOC) J. Dibangoye : IA pour drone (Apprentissage d'un contrôleur)

Les Projets terminés (2013-2017)

Projets

Coopération multi-robots

- ***BQR CROME : CITI-LIRIS (2014-16)***
- **PHC** bi-lateral franco-tchèque ‘MUROTEX’ (2014-15) 14K€, O. Simonin

Autres activités

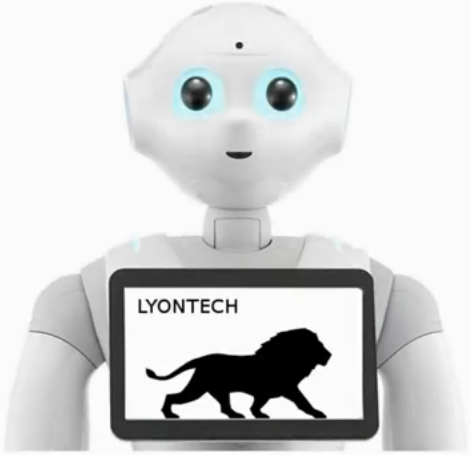
- Talk invités à Lyon et dans la région sur Robotique de service, IA & Robotique
- Conseil pour startups

RoboCup @ Home – Pepper league

Finale à Montréal Juin 2018

Robocup Social Standard Plateforme League (SSPL) Qualification

LyonTech Team



Departement TC

Télécommunications

Enseignements de la robotique :

<u>Option 5TC</u> : **Systèmes embarqués et Robotique**

dont 2 modules (2 x 30h) + 1 module projet (32h) :

- **IA pour la robotique** (O. Simonin, J. Dibangoye)
  - Prise de décision : algo. planification, apprentissage
  - Perception : vision, cartographie, navigation basée vision
  - Coopération multi-robot : stratégies, communications, archi dec/centralisées

- **Matériel et logiciel pour la robotique** (O. Simonin, N. Stouls) :
  - Capteurs, architectures décisionnelles, communications
  - ROS et Expérimentations avec robots mobiles Turtlebot

Projets PIR 3TC : Initiation Recherche (150h / etu.)

- Chaque année, un ou deux projets sur un thème robotique sont proposés
  → 5 à 10 étudiants concernés

+ Premier Cycle

INSA Lyon

Enseignements dans P2I Méctronique et Robotique

Informatique

- Programmation et communication
  - Nicolas Stouls

- IA & Robotique
  - Jilles Dibangoye : Prise de décision et planification
  - Olivier Simonin : Intro Robotique, Bio-inspiration

EPI CHROMA : INSA & Inria

C. Laugier, DR.

Grenoble

e-Motion

2002-2014

Lyon

citi lab

Multi-robot systems

O. Simonin, Prof.
Head of Chroma

Chroma

2015

A. Martinelli, CR.

A. Spalanzani,
MC, HDR

J. Dibangoye,
MC

CHROMA : Research topics

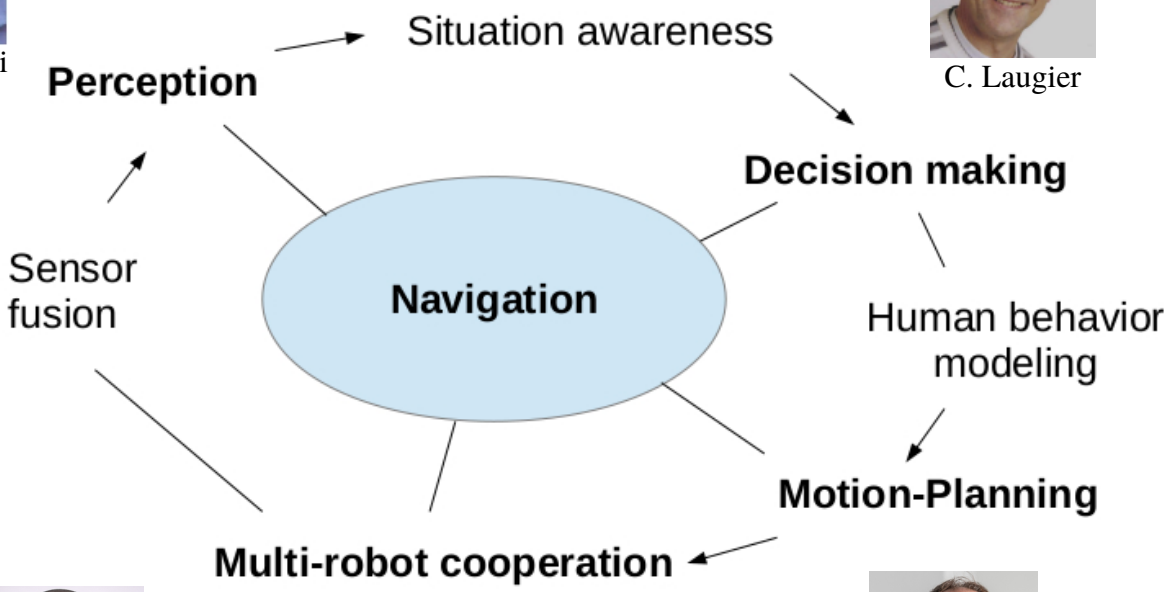

A. Martinelli


C. Laugier


A. Spalanzani


J. Dibangoye


O. Simonin



CHROMA : Research topics

Bayesian perception

Situation awareness

Perception

Decision making

Sensor fusion

Navigation

Human behavior modeling

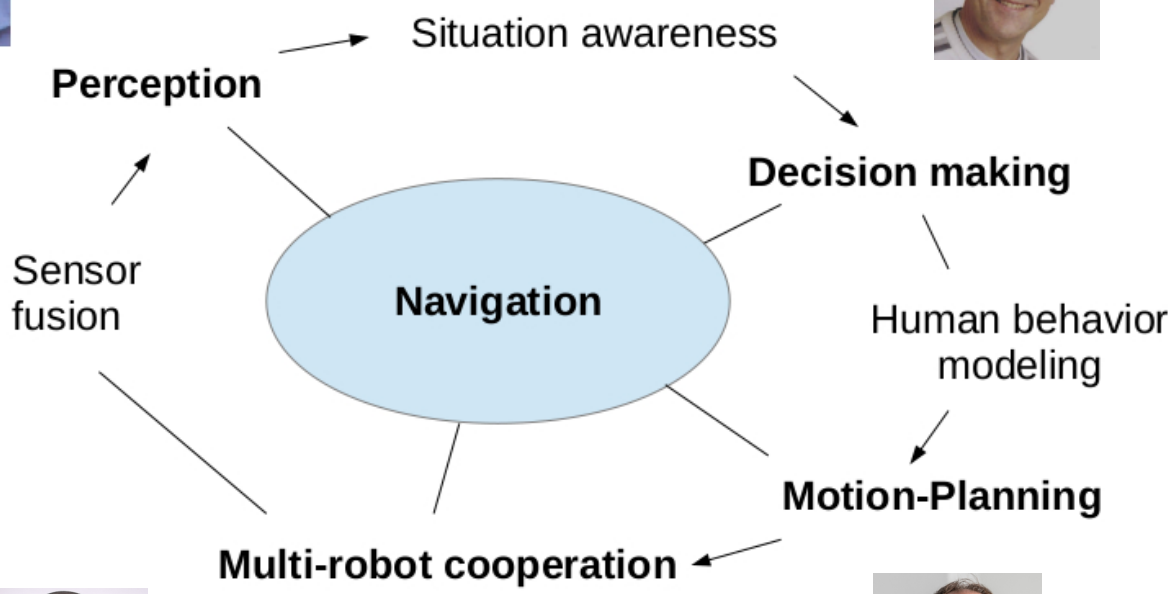
Social navigation

Motion-Planning

Multi-robot cooperation

Seq. Decision-making, Swarm robotics/SMA

CHROMA : Team composition



+ 4 asso. Prof. in Lyon : C. Wolf, L. Matignon (Deleg. Inria), F. Jumel, J.Saraydaryan (CPE)
+ 3 post-doc : A. Renzaglia, O. Erkent, M. Hobballah
+ 6 Engineers : V. Le Doze, JA. David, J. Lussereau, T. Genevois, A. Oliva, S. d'Alu
+ 7 PhD students : M. Barbier, D. Sierra Gonazalez, M. Popescu, P. Vasishta, G. Bono + 2 ext.

CHROMA : Experimental Platforms

...

Scientific objectives & projects

Perception

C. Laugier, A. Martinelli, J. Dibangoye, O. Simonin, C. Wolf*

Sensor Fusion

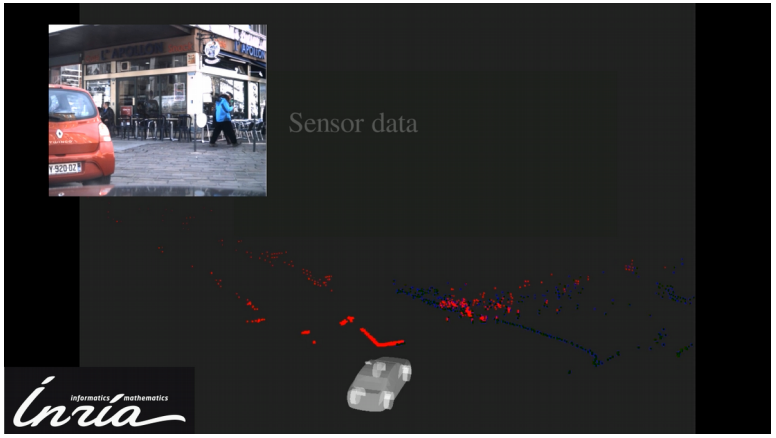
Observability
[Inertial] + [vision] + [laser]

Situation awareness for decision

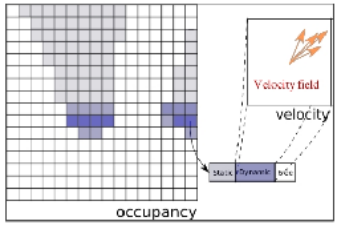
Bayesian perception : grid models [1]
Software & hardware integration (CEA)
Prediction of human behaviors
Learning : GP [2], IRL [3], DeepLearning
Merging **Grid level** and **Object level**

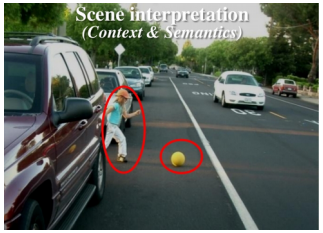
Cooperative perception

Active Sensing
Stochastic optimization



HSBOF grid model of presence and velocity [1]





CROME project 2013-17 (CITI, LIRIS), ICTAI'16

[1] C. Laugier et al., IJRR 2005
[2] M. Barbier et al, IV 2017 [3] D. Sierra Gonazlez et al. ITCS'16

Autonomous vehicles

Projects

Vehicles : European project H2020 "ENABLE" (2016-19), **IRT Perfect,** FUI Tornado

+ Startup (2017)

Contracts with Industrial partners

Renault (2009-), **Toyota** (2006-) : patents, 3 PhD

BA-Systèmes (2016-), Easymile (2016-)

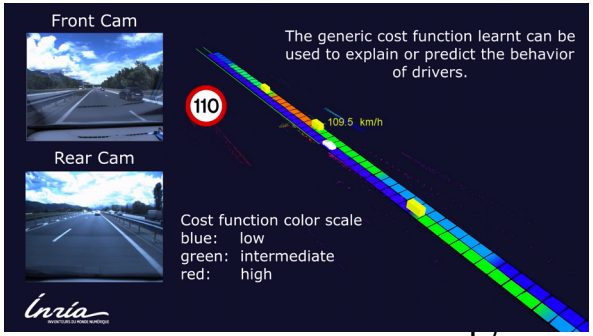
Academic partners

Inria RITS, Tamis, Labo Irccyn Nantes

CEA LETI, UTC, Inst. Pascal

Platforms

2 PhD thesis



Social Navigation

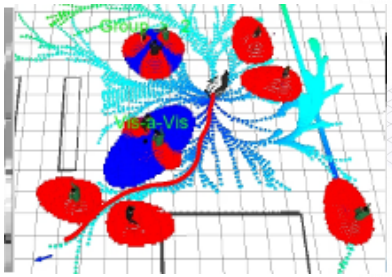
A. Spalanzani, O. Simonin, J. Saraydaryan, F. Jumel, C. Laugier, C. Wolf*

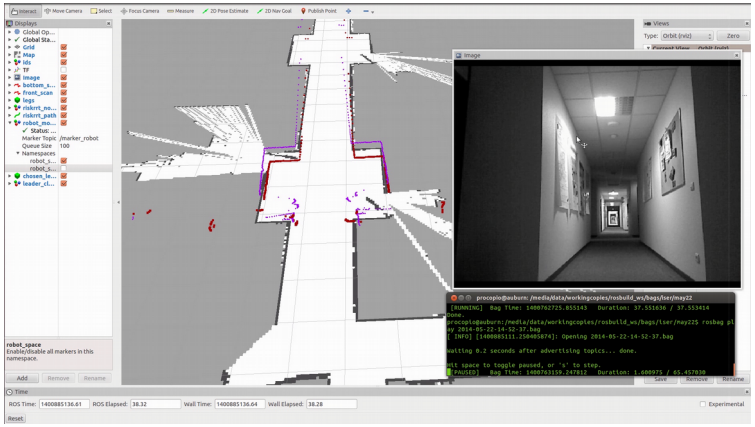
Motion-Planning in **human populated env.**

Modeling and understanding human activities
→ Proxemics [1][2] : human models + perception

Assistance to navigation
→ Planning with risk

Navigation in human flows
→ Flow Grid : learning the flows + revisit cost funct.





[1] E. T. Hall, 1966
[2] A. Spalanzani et al, IROS 2014

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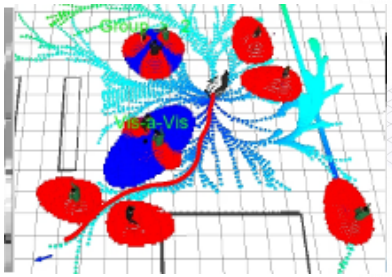
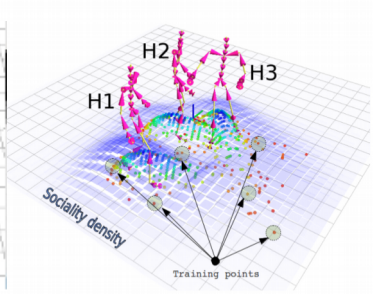
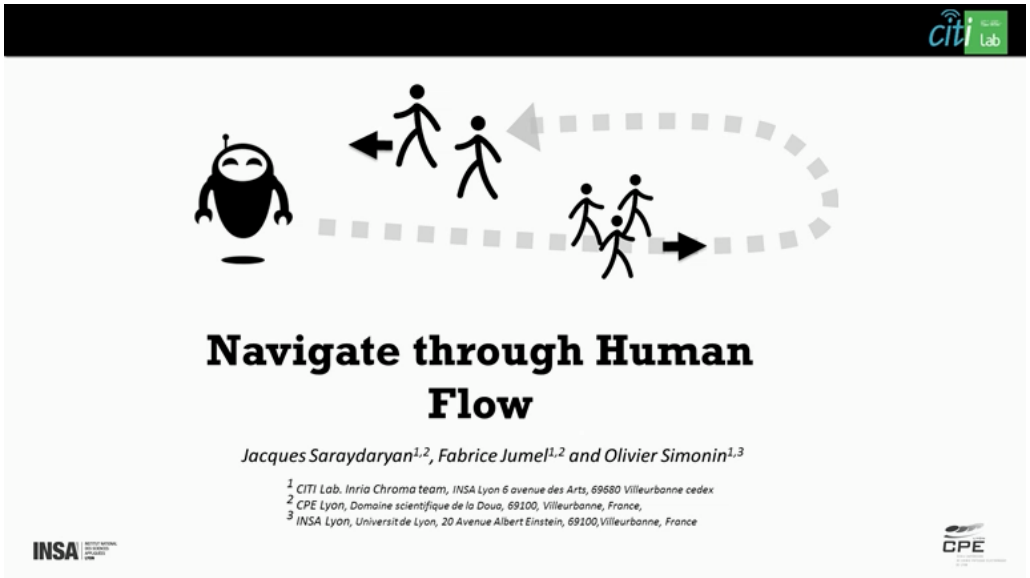
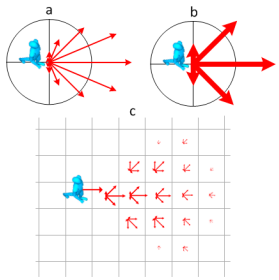
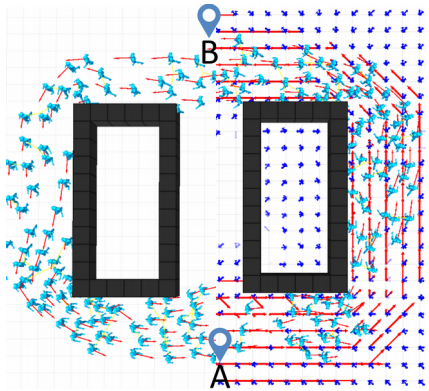






Modeling + simulation + experiments
Robots & Humans - multidisciplinary





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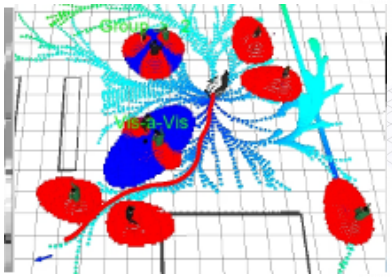

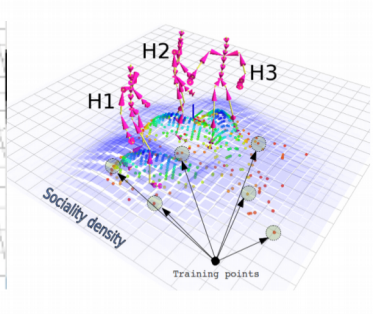

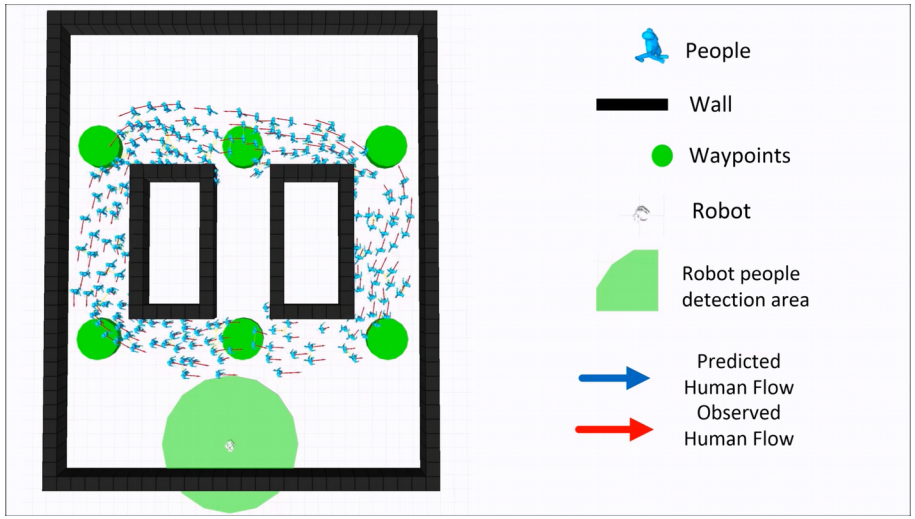

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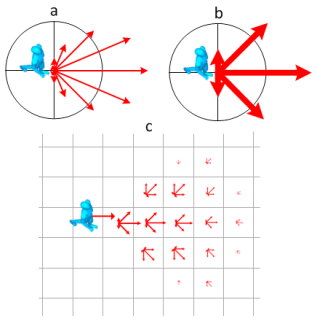


Projects on social navigation

Projects

Vehicles among humans : ANR VALET (2016-18), PIA Campus (2017- 20), **ANR Hianic** (2017-20)

Telepresence robots : **Regional project** TENSIVE (PhD with GIPSA)

Industrial partners

Startups Hoomano, Awabot (Lyon)

Valeo, Gemalto

Academic partners

Inria Pervasive I., RITS (Patis), Lagadic (Rennes)

LIG (Grenoble), Irccyn, LS2N (Nantes)

GIPSA (Grenoble), CPE Lyon

Platforms

2 PhD thesis

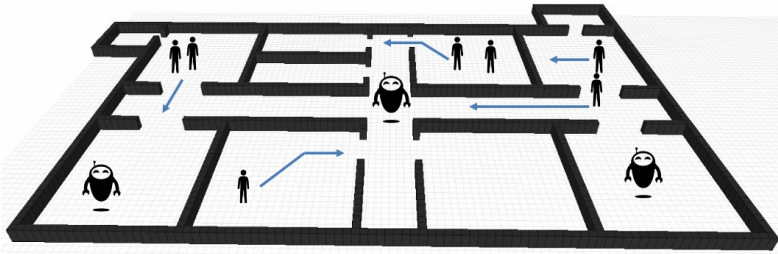
Cooperation

O. Simonin, J. Dibangoye, J. Saraydaryan, F. Jumel, A. Spalanzani, L. Matignon*

Scaling up motion-planning

Heuristics based **decentralized** strategies

Stochastic approaches, eg. [1]



M.R. Planning : exponential time at least [2]

Dealing with limited communication

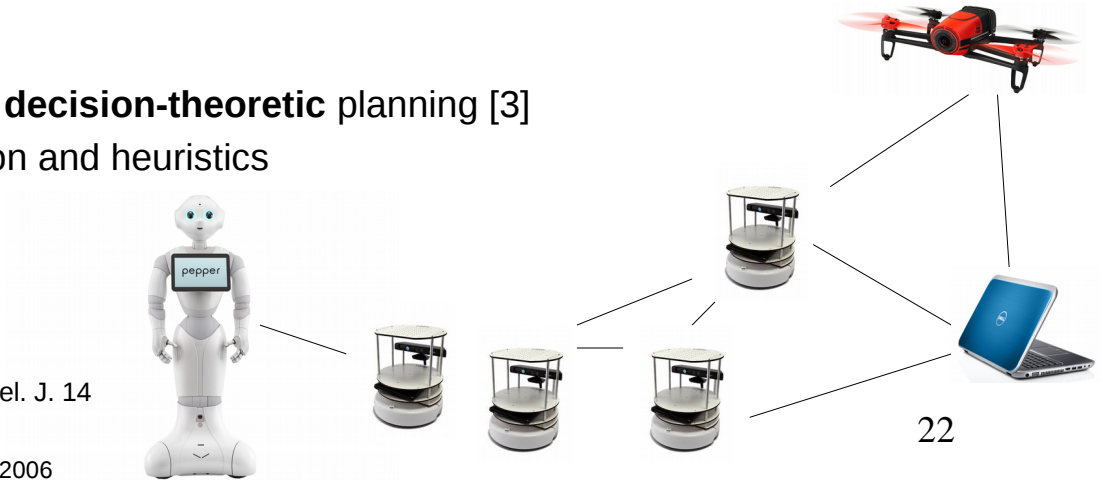
Controlled mobility, limited **connectivity** (graph theo. + local rules)

Protocols/**MiddleW**. (with Agora & Dynamid teams)

Mastering complexity

Swarm models [2] + **Anytime decision-theoretic** planning [3]

Distributed models, optimization and heuristics



[1] A. Renzaglia al., IJRR 2012 [2] Simonin al. Swarm Intel. J. 14
[2] J. Dibangoye et al., IJCAI 2015.

[2] L. Lavalle, Planning Algorithms, Cambridge University Press, 2006

Fleet coordination

Projects

UAVs : INRIA **ADT ‘CORDES’** (2017-18), **ANR** VIMAD (2016-18)

Regional project PhD (2016-19), **INRIA-DGA** PhD (2017-20) with LIP/Inria DANTE

Bi-lateral French-Romanian ‘**DRONEM**’ **PHC** project (2017-19)

Vehicles : INSA-Volvo Chair PhD (2016-19)

Industrial partners

VOLVO group (2016-)

Pole ViaMeca

Academic partners

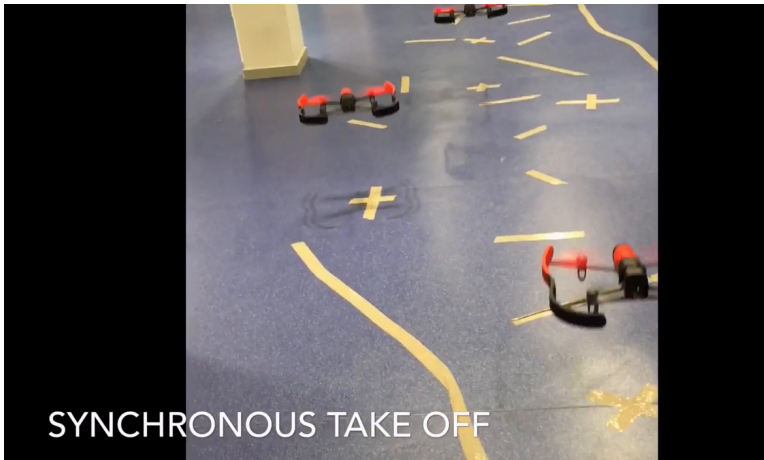
Inria Agora (CITI), Dante, Larsen

MIT, Prague, Cluj. (Roum.)

Platforms

18 Turtlebot 2, 4 UAV Parrot BP2, 4 UAV Crazyflies

3 PhD thesis



Positioning & collaborations

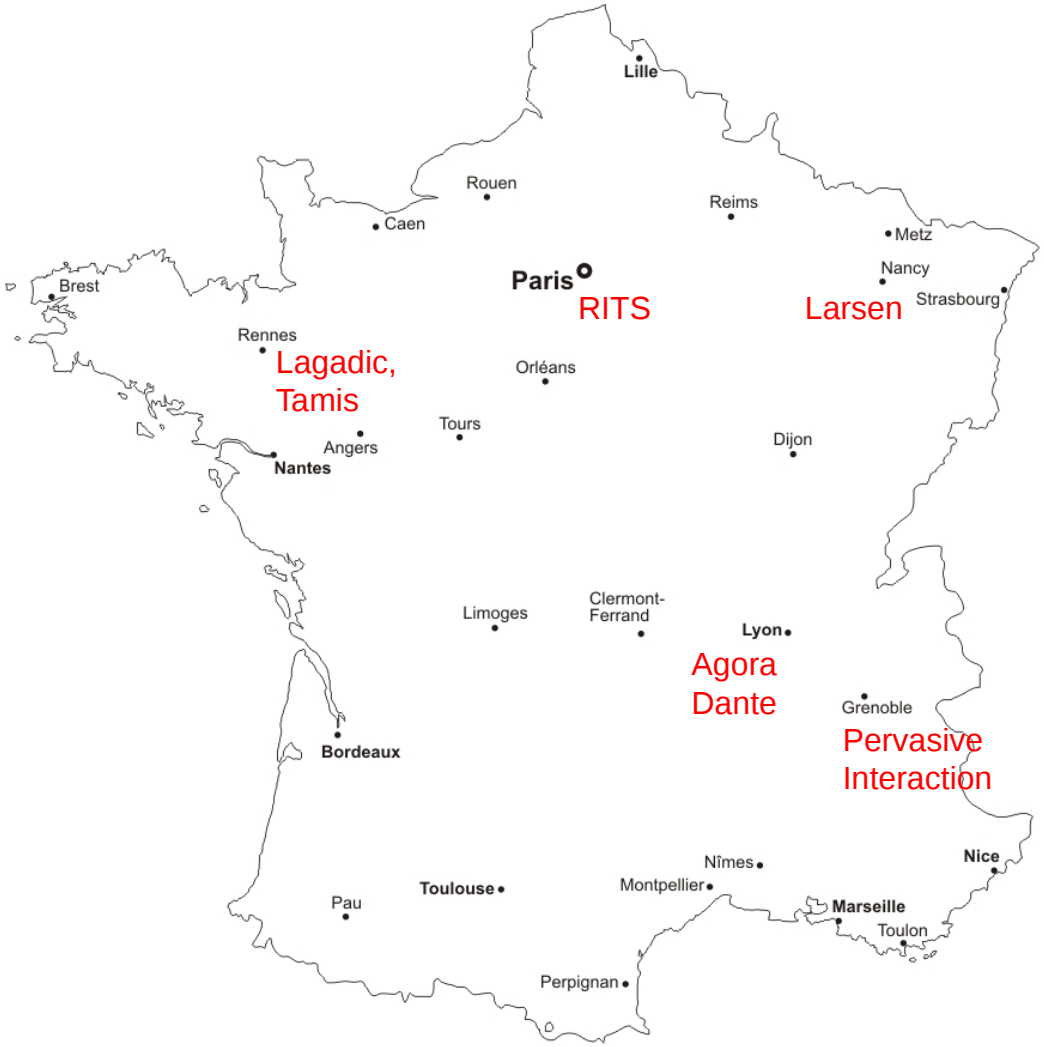
Regional level

INSA Lyon, LIRIS, LIP, CPE,
CITI Agora, Dynamid

Institut Pascal
(CNRS), IRSTEA

LIG, GIPSA, CEA
Inria Pervasive,
Dante

Inria collaborations



International collaborations

Laboratories / Universities

- ETH Zurich - Autonomous Systems Lab *
- KIT Karlsruhe Institut fur Technologie (Prof. C. Stiller lab and Prof. R. Dillmann lab.) *
- UC Berkeley *
- USC Robotic Embedded Systems Lab.
- Vislab Parma (Prof. Alberto Broggi) *
- IceiRA International Center of Excellence in Intelligent Robotics and Automation Research laboratory in Taipei *
- MIT CSAIL L. P. Kaebling* + Northeastern Univ. (C. Amato)*
- Babes-Bolyai Univ. (Cluj, Romania)(G. Czibula)*, CTU Prague Univ. (J. Faigl)*

* Chroma is collaborating at various levels (visits, postdocs, research projects, common publications, etc) with most of these laboratories.