Advanced and Semantic Computing for Complex Situations : Context aware applications

Saïd Tazi

tazi@laas.fr

LAAS-CNRS

Université Toulouse 1 Capitole

SEMAPRO Panel, October 2010

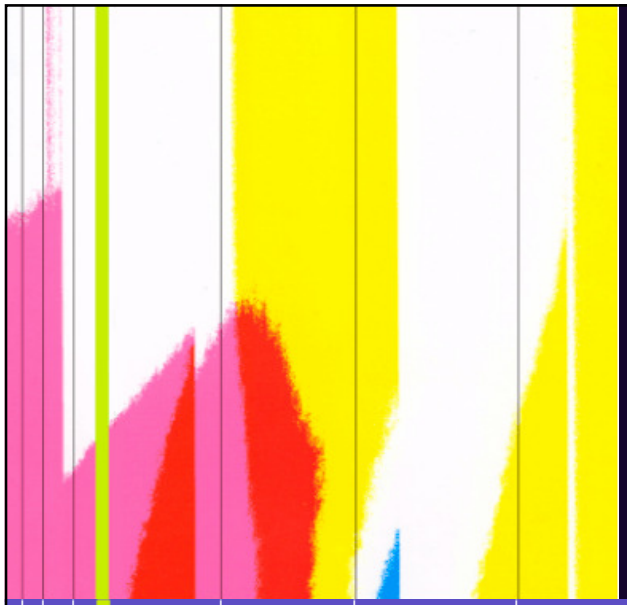
Florence, Italy

Context-aware applications

- Development of context-aware applications is inherently complex
- Applications adapt to changing context information:
  - Physical context,
  - Computational context,
  - User context/tasks
- Reasoning
  - Kind of logics (Monotonicity, …)
  - Engines
  - …

Context

- Physical context,
  - Heterogeneity and mobility
  - Relationships and dependencies
  - Time
  - Imperfection
- Computational context (Constraints)
  - Machine
  - Software
  - Networks
- User context/tasks
  - Intention
  - Interaction



Advanced and Semantic Computing for Complex Situations Panel

Toàn NGUYÊN

Project OPALE

40 ans la révolution de l'information

INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET EN AUTOMATIQUE

INRIA RHÔNE-ALPES

ADVCOMP2010, Firenze (I), 25-29 October 2010

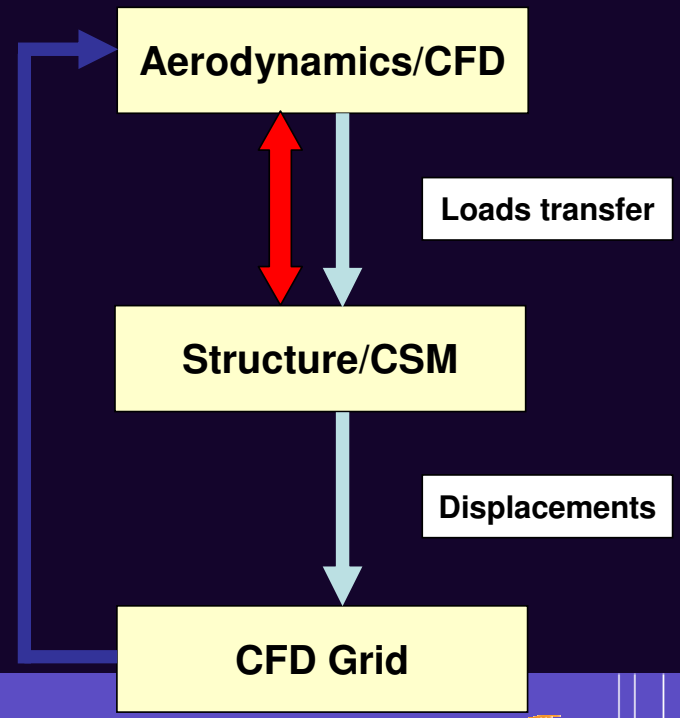
Outline

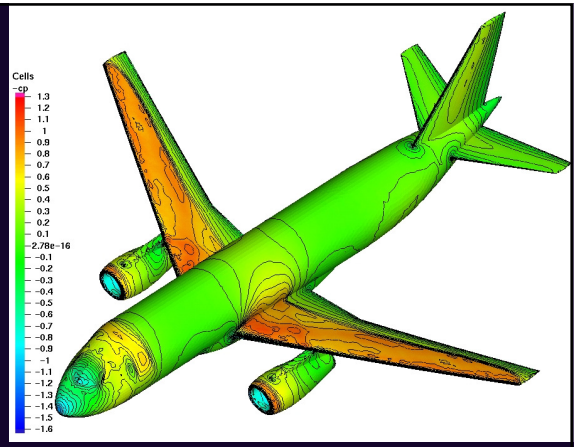
- Examples
- Keywords
- Multiple Organizations
- Multiple disciplines
- Requirements

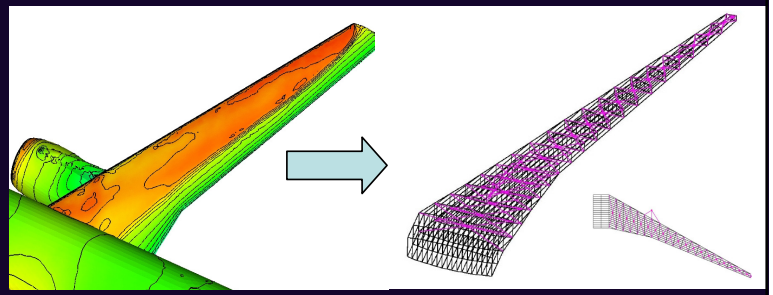
Fluid Structure Interaction

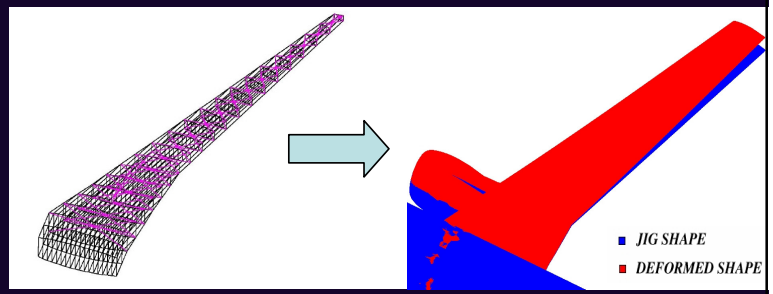
AleniaAeronautica

Aero-structural Design Process



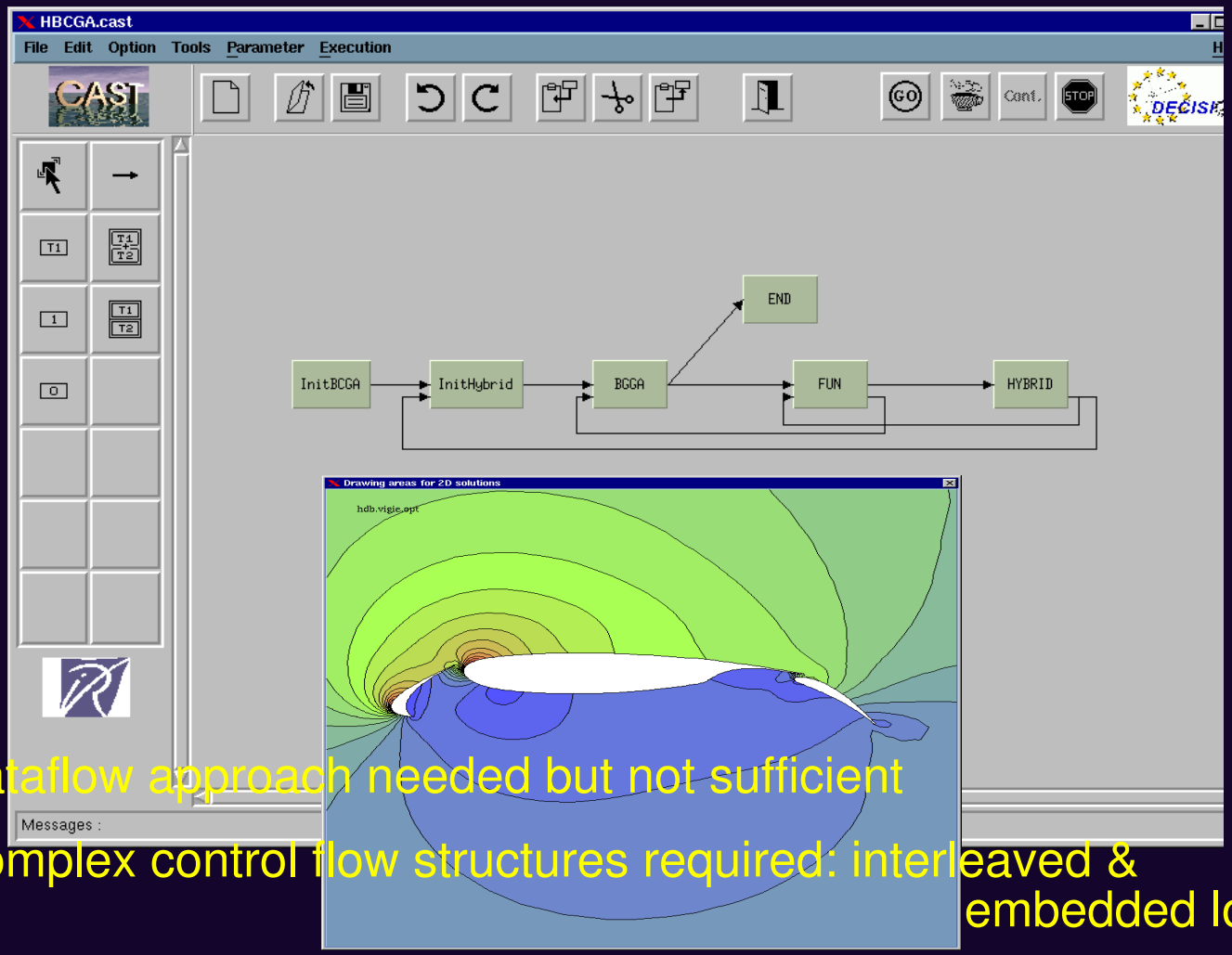






40 ans la révolution de l'informatique

INRIA RHÔNE-ALPES

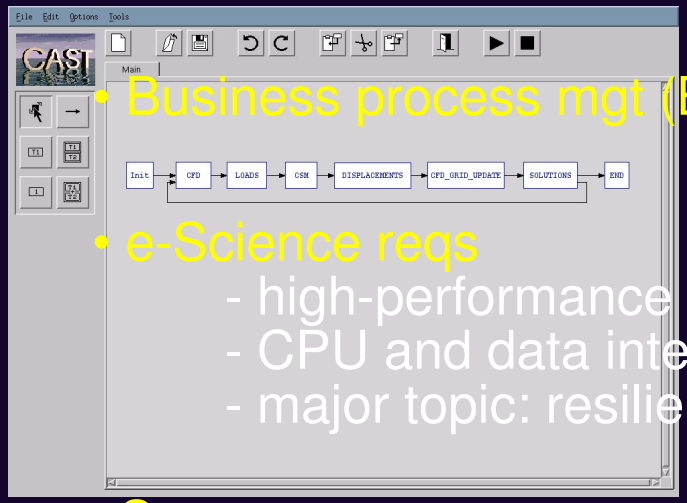


- Dataflow approach needed but not sufficient
- Complex control flow structures required: interleaved & embedded loops

Keywords

- Baseline
  - complex multidiscipline applications (nuke powerplant sim: thermo, hydro, CFD, CSM, …)
  - complex infrastructures (hardware & software)
  - complex discipline interactions (multiscale, multimodel)
- Outcome
  - fault-tolerance (hardware, system) not sufficient
  - new HPC requirements: exascale, distributed, long …
  - high-level GUI
  - strong need for application-level error management
- Large-scale evolving multidiscipline applications…

e-Science Workflow rationale



- Business process mgt (BPM) & e-Science requirements diffe
- e-Science reqs
  - high-performance parallel computing: Petascale era
  - CPU and data intensive: towards Exascale (2018…)
  - major topic: resilience (ex: IESP Roadmap, CIFTS…)

www.exascale.org pp45-49

- Support
  - dataflow AND control flow
  - directed acyclic graphs (DAG) AND loops, conditionals
  - distributed AND clusters, HPC…
  - hierarchical composite workflows AND external softwar

International Exascale Software Project

www.exascale.org

Roadmap V1.0, May 2010, pp45-49

- 4.3 Applications
- 4.3.3 Application support: Scientific Data Management p. 45

  Scientific Workflow Tools p. 45

  4.3.3.3 Recommended Research Agenda p. 47

  2012-2013 Workflow tools with fault-resiliency specification capabilities
- 4.4 Crosscutting Dimensions p. 47

  4.4.1 Resilience p. 47

  2010-2012 Checkpoint size reducing techniques p. 49

International Exascale Software Project

www.exascale.org

Roadmap V1.0, May 2010, pp59-62

- 4.5 Summary of X-Stack priorities

  Application-managed resilience (uniquely exascale & critical)

- Needed capabilities

  Algorithms: Fault tolerance/resilience p. 60
  Scientific Data Mgt: Scientific Workflow Tools (critical) p. 61
  Resilience: App guided fault management (critical) p. 62
  Resilient applications & algorithms
  Fault isolation/confinement (critical)
  Experimental environment (critical)

Requirements

- We need formal specifications of scientific processes: data collection, analysis, computation & publication
- Support sharing scientific processes descriptions across organizational and discipline bounderies
- Ability to evolve processes, compare, identify differences
  - Fault-tolerance & Resilience capabilities in evolving applic.
    - asymmetric checkpoints
    - dynamic rule specifications
    - dynamic extensions to workflows
    - prototype deployment and testing on industrial scenarii

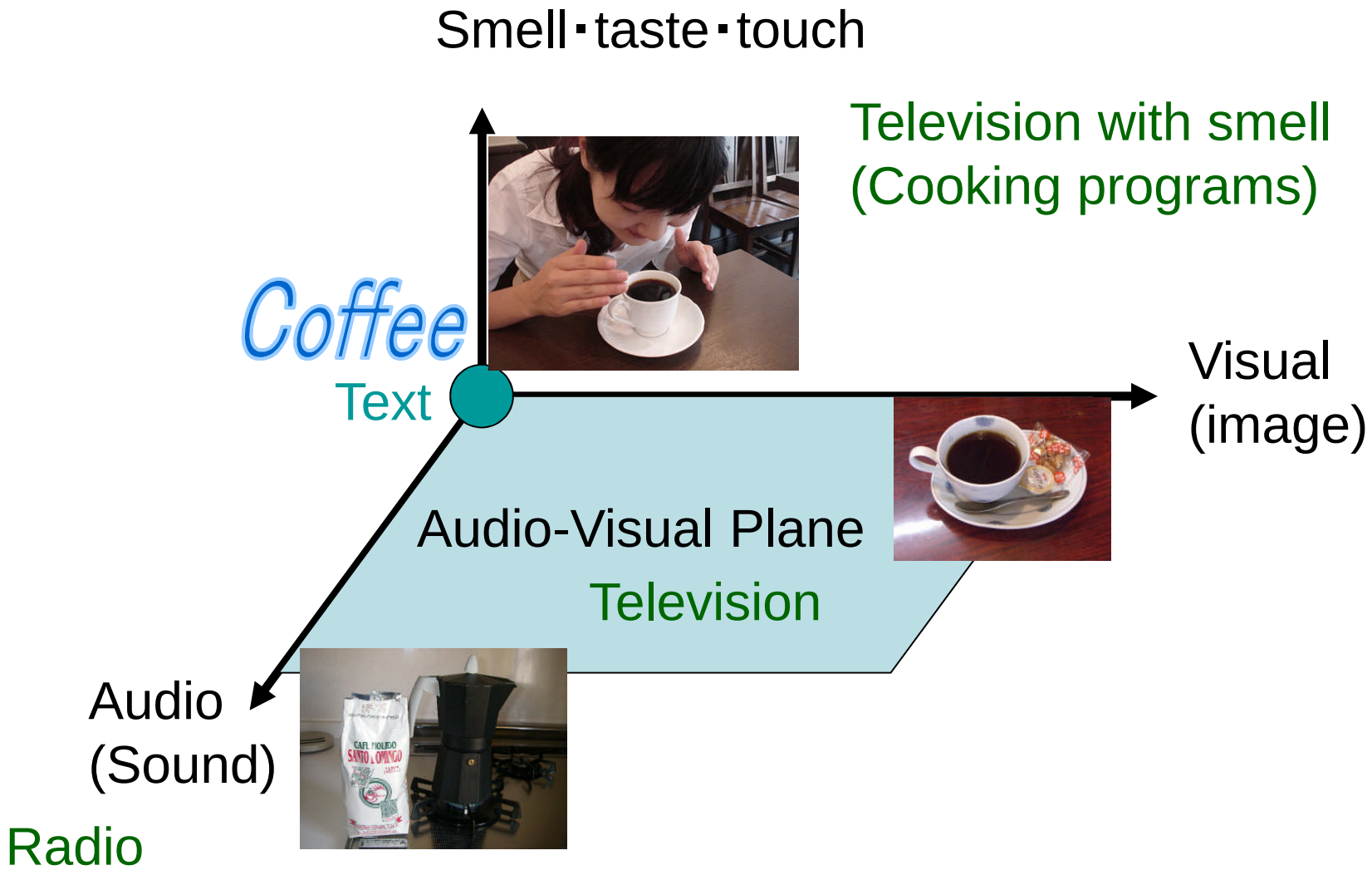
THANK YOU !
Questions ?

http://www-opale.inrialpes.fr

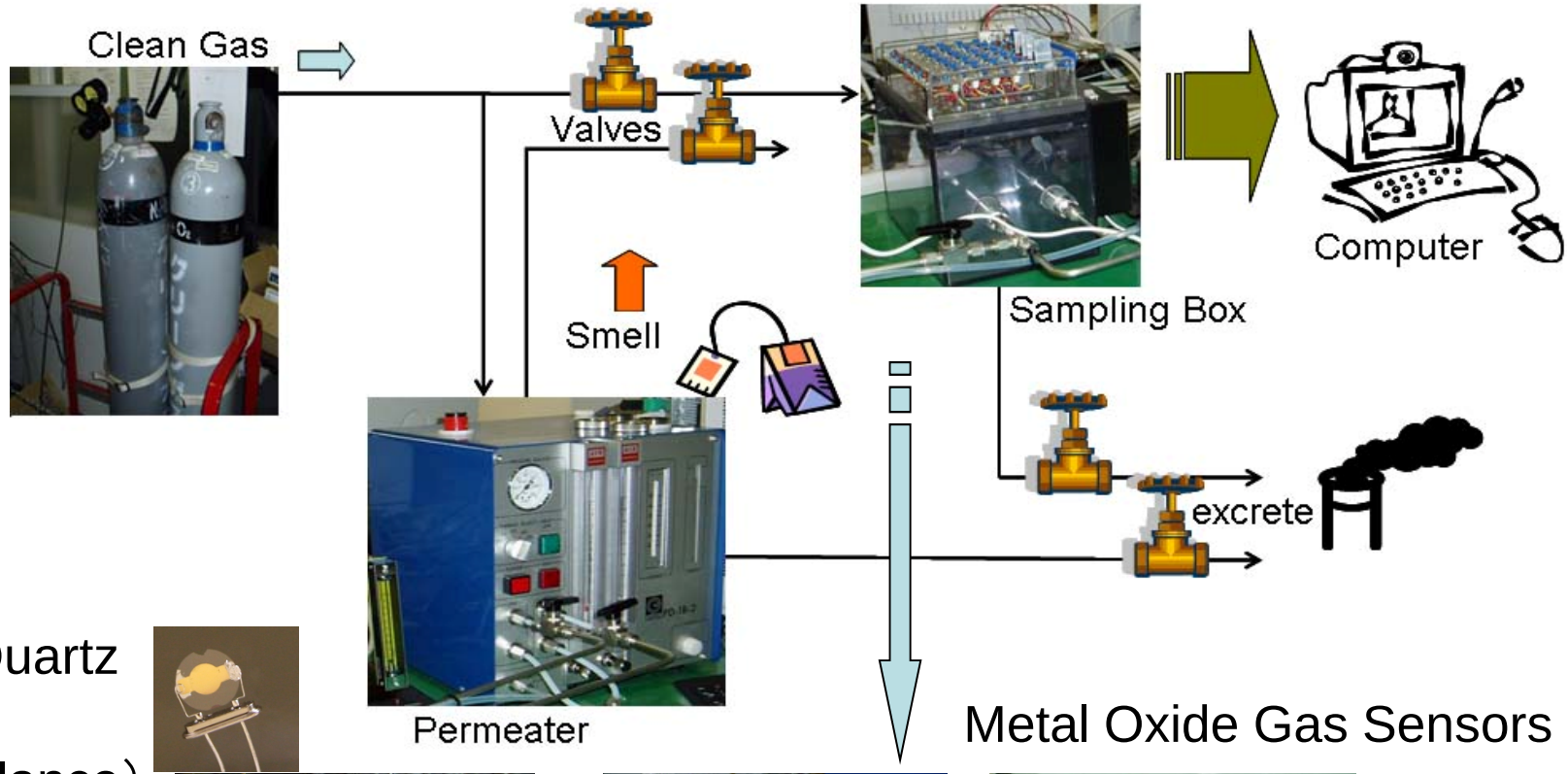
- http://www-opale.inrialpes.fr/wccm2010.pdf
- http://www-opale.inrialpes.fr/hpcs2010.pdf
- http://www-opale.inrialpes.fr/eccomas2010.pdf

Phone : +33 476 61 52 40
Toan.Nguyen@inrialpes.fr

Human has five senses



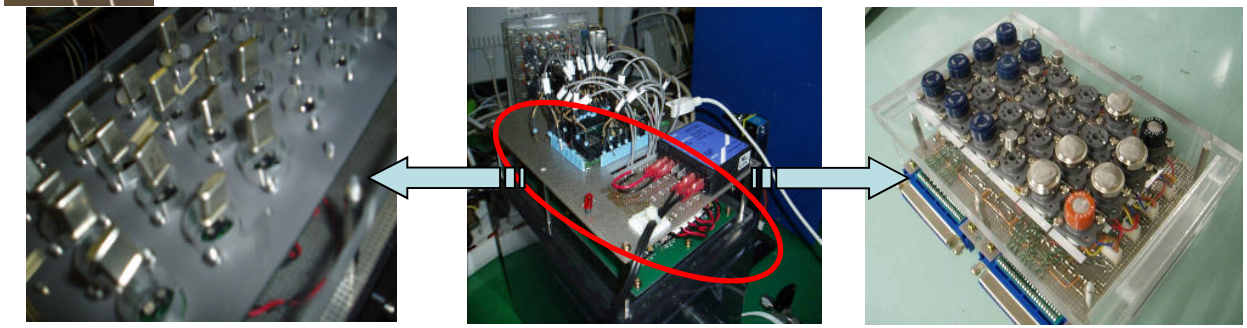
Various sensors to measure smells



QCM (Quartz Crystal Microbalance)

Metal Oxide Gas Sensors

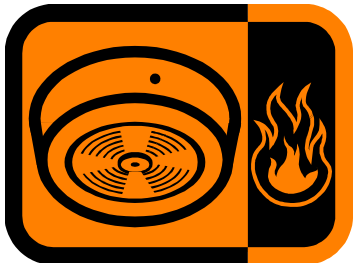
QCM Sensors



Various Applications of Smells

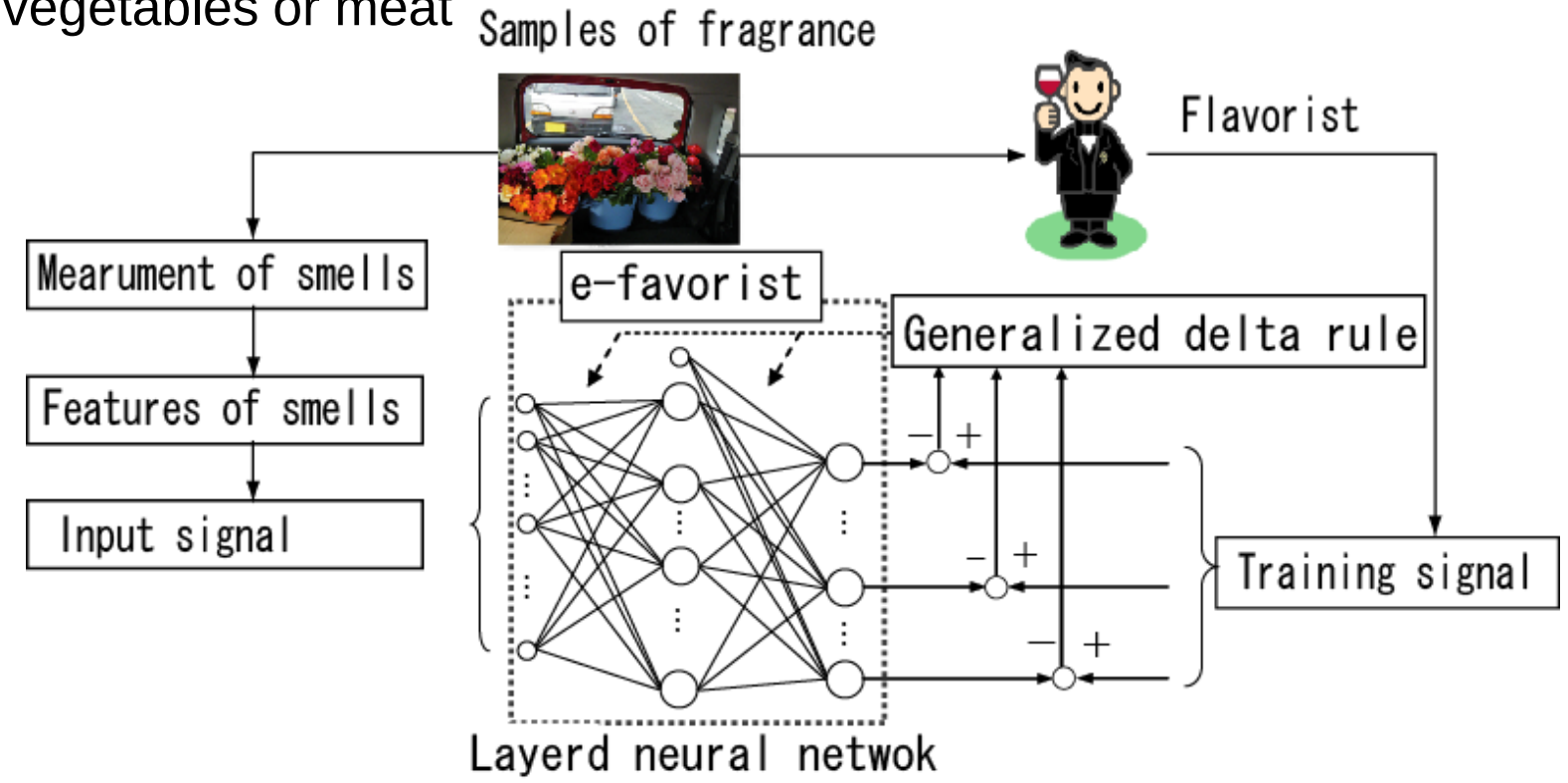
Detector of rot in vegetables or meat

TV with Smell



Fire alarm

Police dog



Advanced and Semantic Computing for Complex Situations

Michele Ruta – Politecnico di Bari

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The Problem

Have you ever tried to buy/search a resource on-line?

- A new Apple MacBook on eBay.com
  - 3569 items found
- A room in an apartment to share in New York on Craigslist
  - 3957 items found
- A used Toyota Camry in the San Francisco area on cars.com
  - 642 vehicles found
- A soul mate on Plentyoffish.com
  - 600+ results

Exploit semantic technologies to represent:

- the semantics of a **resource** (ads, services, objects, ...): "*a twin room is a room with two beds*".
- represent **queries** as complex descriptions. Express a query over both qualitative and quantitative information: "*I am looking for a non smoking room and I would like to spend less than €200 per month*".

Definitions

[MATCHMAKING]

Matchmaking is an information retrieval task whereby queries and resources are expressed using semi-structured text in the form of advertisements, and task results are ordered (ranked) lists of those resources best fulfilling the query.

[SEMANTIC MATCHMAKING]

Semantic matchmaking is a matchmaking task whereby queries and resources advertisements are expressed with reference to a shared specification of a conceptualization for the knowledge domain at hand, i.e. an ontology.

Semantic Web of Things

- Micro devices bridge the gap between physical and digital world
- Peculiarities:
  - small storage space
  - little or no processing
  - short-range, low-throughput wireless links
- Each micro device provides a small amount of information
- Mobile computing devices (phones, PDAs, etc.) provide and/or use services/resources in ad-hoc networks
- An ad-hoc network is a very unpredictable environment
  - Location of devices could change continuously
  - Information about services is often unavailable
- Resource discovery approaches should be redesigned

Main issues

- More flexibility
- A decentralized approach is needed
  - A node should not be depending on some other node to advertise/register services
  - Each resource should be autonomously exposed
  - Applications on the other nodes should be able to autonomously perform a discovery
- String-matching is inadequate in advanced scenarios
  - Need to submit articulate requests, to obtain adequate answers
  - Need to cope also with non-exact matches to grant satisfaction of user request as much as possible
- What technologies could help?

Pervasive resource discovery

- Semantic-enhanced approaches allow to overcome limits in resource discovery due to unpredictability
- Semantic Web of Things (SWoT)
  - Peculiarities of the "object networks" make them not trivially assimilable to the Web
- Need for a logic-based infrastructure to build a SWoT
  - Decentralized architecture
  - Integration in most common wireless technologies (RFID, 802.11, BT, ...)
  - Preliminary knowledge dissemination
  - Annotation compression
- Reasoning in mobile and pervasive environments
  - Lightweight version of most common inference algorithms

Results

Done

- Exploit theory and technologies of **Semantic Web vision**
- Integrate semantic-enhancements in a unified resource discovery framework of most **common wireless standards**

To do

- A traditional KRS is needed as a reasoning engine
  - Porting on **resource constrained devices** (PDAs, ...)
- Reasoning provided by single **centralized** wireless hotspot
  - Single point of failure
  - Limited flexibility and scalability for applications
- **Verbosity** of semantic-based languages and formalisms

Thank you

- Publications list at

  http://sisinflab.poliba.it/ruta/index.php?page=publications&author=Ruta&pg=-1
- Web site

  http://sisinflab.poliba.it/ruta
- E-mail address

  m.ruta@poliba.it