

FP7 ICT

Challenge 2

Cognitive Systems, Interaction, Robotics

Info Day
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Unit INFSO E5: Cognitive Systems and Robotics
Directorate General "Information Society and Media"
European Commission

OVERVIEW

1. Research in Cognitive Systems, Interaction, Robotics

- i. EU research aims
- ii. Motivation
- iii. Origins
- iv. Work Programme 2007-08
 - What sort of Research?
 - Major Challenges
 - Research Questions
- v. Long term aims & Impact

2. Practical Issues - dates, definitions, info sources

PART 1

Research in Cognitive Systems, Interaction, Robotics

EU Research Aims

The Treaty on European Union

Chapter on Research and Technological Development

Article 163

"The Community shall have the objective of strengthening the scientific and technological bases of Community industry and encouraging it to become more competitive at international level while promoting all the research activities deemed necessary by virtue of other Chapters of this Treaty."

Motivation

artificial systems should be able to function effectively in circumstances that were not planned for explicitly when the system was designed - they should

- ⊙ respond intelligently to gaps in knowledge, and to situations or contexts that have not been specified in their design (robust, versatile)
- ⊙ be more effective in improving performance (predict, anticipate), and natural in dealing with people (tolerant to ambiguity & uncertainty that is a consequence of dealing with humans)

requires new engineering principles & approaches

Motivation

"If you invent a breakthrough in artificial intelligence, so machines can learn," Mr. Gates responded, "that is worth 10 Microsofts." (Quoted in NY Times, Monday March 3, 2004)

<http://www.nytimes.com/2004/03/01/technology/01bill.html?ex=1079158195&ei=1&en=8bc59e7df0b214eb>

<http://www.interesting-people.org/archives/interesting-people/200403/msg00003.html>

Origins

FP5, FP6

- ⊙ *Cognitive Vision Systems*
- ⊙ *Cognitive Systems*

R&D: rethinking systems engineering

FP6

- *Multimodal Interfaces*
- *Advanced Robotics*

R&D: achieving naturalness, versatility, robustness at system level

- ⊙ from constrained to **real-world** environments
- ⊙ from application-specific to **general solutions**
- ⊙ from component methods to a **systems approach**
- ⊙ from a 'monodisciplinary' research effort to **working across disciplines**
- ⊙ **scientific foundation** - concepts & methods, theoretical contributions, experimental validation
- ⊙ **enabling technology** - for robotics & automation, natural language understanding, HMI, etc

Origins

Research communities exist:

- ⊙ euCognition, PASCAL, HUMAINE, ENACTIVE, EURON, ..
- ⊙ EUROP European Technology Platform in Robotics
- ⊙ Projects (FP6):
<http://cordis.europa.eu/ist/cognition/projects.htm>
<http://cordis.europa.eu/ist/ic/projects.htm>

but ... further integration necessary (research perspectives, efforts, resources, know-how, educational curricula,...)

Work Programme 2007-08

Target outcome a) (IPs, STRePs)

artificial systems that:

- © can **achieve general goals** in a largely unsupervised way, and persevere under adverse or uncertain conditions; **adapt**, within reasonable constraints, to changing service and performance requirements, without the need for external re-programming, re-configuring, or re-adjusting.

and/or

- © **communicate** and **co-operate** with people or each other, based on a well-grounded understanding of the objects, events and processes in their environment, and their own situation, competences

Work Programme 2007-08

Focus on one of 3 areas

- © robots handling different objects and operating autonomously or in cooperation with people
 - *may call for manipulation & grasping, navigation, locomotion, obstacle avoidance, interaction with humans,...*
- © systems (incl. robots, sensor networks) monitoring and controlling material or informational processes
 - *may call for detection, recognition, classification of objects, events or processes,...*
- © multimodal interfaces and interpersonal communication systems understanding language, gestures
 - *may call for a deep understanding of human physical and cognitive capabilities, communication needs and contextual constraints,...*

Work Programme 2007-08

A key question

How should systems pertaining to these areas be designed and built so that they are more robust, flexible, effective, natural and where necessary or desirable, safer and more autonomous than what is possible today?

but,... how can we specify what it means to be robust, flexible, etc?

Work Programme 2007-08

Note

emphasis is scientific and technological advance - not about application development;

role of applications is to provide research questions and to demonstrate the impact of conceptual or technical innovation.

Work Programme 2007-08

Identify the type(s) of system(s) you want to build and explain why you cannot build it/them now - what sort of know-how your project is expected to generate and how will it be relevant for others?

Work Programme 2007-08

Work should (as appropriate)

- ◎ develop and apply engineering approaches,.. that ensure reliability, flexibility, robustness... criteria for benchmarking
- ◎ contribute to theory: ... learning in artificial systems; interpretation of sensor data, design and architectures ...
- ◎ explore:
 - ◎ use of advanced components, platforms,...based on new materials or hardware design (incl. biomimetic),..
 - ◎ new/bio-inspired information processing paradigms, models of natural cognition, emergent behaviour,..
 - ◎ new approaches to language understanding and generation

Work Programme 2007-08

Challenges

- © a key issue is how these systems should work - greatly improving robustness etc. requires rethinking the way systems are engineered
- © theories are needed - systems theories, software architectures, control theories, modelling theories, etc - that will allow us to build these types of systems
- © engineering progress will depend on advancing scientific understanding of what both natural and artificial systems can and cannot do, and how and why
- © integration of disciplines: artificial intelligence, computer vision, natural language, robotics,... computational neuroscience, cognitive science, psychology,...philosophy of mind,...mathematics,...

Work Programme 2007-08

Target outcome b) NoEs

- ... learning in artificial systems, the requirements for cognitive capacities of robotic, interactive systems and language support systems,
- ... experimental scenarios, resources for experimentation, performance metrics and definitions of autonomy levels

A principled methodology: analysing what is needed to achieve our long term goals *(as opposed to asking how do we improve what we have already achieved)*;

R&D towards developing: a shared understanding of detailed requirements, and approaches (models, techniques, ...) to meeting them;

Methods and experimental scenarios for: evaluating performance, to demonstrate generality, to measure robustness, etc.

Work Programme 2007-08

Target outcome c) CSAs

Coordination at EU-level

- who is supporting this type of research in the EU?
- gather momentum and focus efforts of the many and varied relevant research communities
- aim at generating additional funding support and/or new funding initiatives

Work Programme 2007-08

Research questions related to

- high-level cognitive skills - integration
 - autonomy - varieties, mechanisms
 - rich-sensory motor skills - how they may be acquired
 - manipulation and grasping - recognising affordances
 - dependability - design/implementation options
 - modelling - degrees of abstraction
 - object representation/recognition - invariance/disambiguation
 - behaviour representation/interpretation - invariance/disambiguation
 - pattern discovery and classification - for prediction/anticipation
 - collective behaviour - how to direct towards common goals
 - visualisation and manipulation - rendering of representations
 - natural language - its role in cognition
 - architectures - integration, auto-regulation, function of memory
- and many more, including what can we learn from natural systems

Work Programme 2007-08

Identify the type(s) of system(s) you want to build and explain why you cannot build it/them now - what sort of know-how your project is expected to generate and how will it be relevant for others?

longer term aims and impact

create and develop a scientific foundation for artificial cognitive systems (ie, artificial systems that perceive, understand, learn and develop through individual or social interaction with their environment)

...by deriving inspiration from the study of natural cognitive systems... research will also help improve our understanding of the nature of cognition and its underlying structures and functions in biological systems

artificial cognitive systems will provide an enabling technology for all sorts of applications involving interaction with the real-world environment and its inhabitants

PART 2

Practical Issues - dates, definitions, info sources

Cognitive Systems, Interaction, Robotics: 2007-08

Key Dates

Call 1: Dec 22, 2006, closes May 8, 2007

Hearings: week of June 25, 2007

Funding: 96 M€

Aim to start projects by end of year

Call 3: Dec 2007, closes Mar 2008

Funding: 97 M€

Definitions

Funding schemes – relevant for the current call:

1. Collaborative Projects (CP)
 - 1.a Integrated project (IP) - objective driven research programme whose primary deliverable is new knowledge.

Typically encompasses: research work (clearly specifying innovation vs state-of-art and justifying methods proposed); system integration & validation; demonstration & comparative performance evaluation; dissemination of results; training & awareness.

Definitions

Funding schemes - ctd

1. Collaborative Projects (CP)
- 1.b Specific targeted research project (STReP) – well- defined and precisely focused research aimed at generating new knowledge.

In addition to being more focussed it would typically include just research and its dissemination

Definitions

Funding schemes – ctd

2. Network of excellence (NoE)

- programmes of joint research & resource sharing which contribute to reinforcing & sustaining scientific excellence. Would typically comprise:

- a convergent conceptual framework for integrating diverse researchers* whose problems, techniques and solutions need to be brought together to progress R&D towards identified common goals (JPA);

(including a core team of excellent researchers to execute the JPA)

Definitions

Funding schemes - ctd

2. Network of excellence (NoE)

ii. dissemination objectives incl. production of web-site, educational materials, demos, ... organising interdisciplinary workshops, conferences, ... dissemination through journals and books;

iii. development of experimental scenarios, resources for experimentation, performance metrics, *a framework for sharing* tools, knowledge about tools & for interfacing tools, incl. forms of representation, ontologies, ... data-libraries, test-sets ... etc;

Definitions

Funding schemes - ctd

Coordination and Support action (CSA)

Coordination Action - supports networking and coordination of research.

Would typically comprise: a set of actions such as information exchange, definition and implementation of coordinated actions.

Indicative Figures

- ⊙ IPs - up to 5 years, ~ 6 to 10 partners
- ⊙ NoE - up to 5 years, ~ up to 15 contractors
- ⊙ STRePs - up to 3 years, ~ 4 to 6 partners
- ⊙ CA - up to 3 years, critical mass

project funding commensurate with expected results & impact!

funding of individual partners depends on role & input!

Cognitive Systems, Interaction, Robotics: *2007-08*

Hints

- © identify the type(s) of system(s) you want to build and explain why you cannot build it/them now - what sort of know-how your project is expected to generate and how will it be relevant for others?
- © **interdisciplinarity** encouraged - ideas come from perspective!
- © you may aim to complement or extend current projects - rather than try to be different (see links at end) but, be ambitious - aim beyond the state-of-the-art!
- © involve **only** those partners needed to achieve the goals and no more
- © industrial partners, where present, must have an **economic** interest in the research output

Cognitive Systems, Interaction, Robotics: 2007-08

A key issue:

*to make systems more robust, flexible, effective,
natural, safe, autonomous ...*

*... we have to rethink the way systems are
engineered ...*

... grounded in a solid scientific foundation.

la cuestión llave

"No preguntes qué puede hacer la ciencia por tí, sino qué puedes hacer tú por la ciencia"

(J.F. Kennedy / H.-G. Stork)

Cognitive Systems, Interaction, Robotics: 2007-08

Links

More (background document, FP6 project descriptions, presentations,...) at

©<http://www.cognitivesystems.eu>

©<http://cordis.europa.eu/ist/ic>

See also

©<http://www.eucognition.org>

©<http://www.roboticsplatform.com>

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