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Project-Team MAIA

MAchine Intelligente Autonome

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THEME COG

Activity Report

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1. Team

Key words: Distributed Artifical Intelligence, Decision Theory, Reasoning under Uncertainty, Learning, Planning, Diagnosis.

Team Leader

François Charpillet [Research director (DR) INRIA]

Administrative assistant

Martine Kuhlmann [CNRS, part-time, until mid-May]
Céline Simon [INRIA, part-time, since mid-May]

Research scientists

Alain Dutech [Research associate (CR2) INRIA]
Bruno Scherrer [Research associate (CR2) INRIA, since October]

Faculty members

Christine Bourjot [Assistant professor, U. Nancy 2]
Anne Boyer [Assistant professor, U. Nancy 2]
Vincent Chevrier [Assistant professor, U. Nancy 1]
Jean-Paul Haton [Professor IUF, U. Nancy 1, member of l'Institut Universitaire de France (Chair of Modélisation informatique des processus perceptifs et cognitifs)]
Alexis Scheuer [Assistant professor, U. Nancy 1, until August]

Post-doctoral fellows

Olivier Buffet [ATER, U. Nancy 1, until mid-February]
Romaric Charton [ATER, U. Nancy 2, until August]
Frank Gechter [ATER, IUFM de Lorraine, until August]
Laurent Jeanpierre [ATER, U. Nancy 1]
Lhassane Idoumghar [ATER, U. Strasbourg, until August]
Maan El-Badaoui-El-Najjar [INRIA, since mid-October]
Amine Boumaza [CNRS-INRIA, since mid-November]

Ph.D. Students

Vincent Thomas [MENRT scholarship]
Simon Le Gloannec [INRIA/CNRS scholarship, co-directed by A. Mouaddib, Professor, University of Caen]
Daniel Szer [INRIA scholarship]
Raghav Aras [INRIA scholarship, U. Nancy 1]
Cherif Smaili [Egide scholarship, DRT student, U. Nancy 2]
Julien Thomas [DRT student, U. Nancy 2, since mid-November]
Jamal Saboune [U. Technologies Troyes Scholarship]
Sylvain Castagnos [INRIA scholarship, U. Nancy 1]

Project Technical Staff

Régis Lhoste [INRIA Engineer]
Loïc Pelissier [INRIA Engineer, until october]
Cedric Rose [Engineer associated with the development of Dialhemo]

2. Overall Objectives

Research in the MAIA Project is at the confluence of two areas : *decision theory* and *autonomous agent and multi-agent systems*. We are thus interested in developing methodologies and software tools for the modelling and simulation of systems composed of multiple autonomous agents based on real or virtual environments. We use a fairly wide definition of 'agent': we define an agent to be an entity capable of observing its environment and interacting with it and with other agents placed in it. Moreover, we think of the agent as being capable of satisfying or attempting to satisfy its own goals, and having the ability to be influenced or manipulated by other agents. Such a definition permits us to have an agent represent a software system, a robot, a human being or an animal.

3. Scientific Foundations

3.1. Introduction

We conduct our scientific investigations using two major approaches: the formal framework and the nature-inspired framework. In the formal framework, we study Markov decision processes and reinforcement learning. Under the nature-inspired approach we study an approach in which the collective behaviour of animals such as spiders or rats constitute a basis for designing systems in which a set of very simple entities interact with each other and exhibit intelligent collective behavior. This latter approach is based on the basic idea that surprisingly intelligent behavior can arise from fairly simple control mechanisms interacting with a complex environment. The team has strong connection with researchers in other institutions that are studying the behavior of social animals.

3.2. The Formal Approach

3.2.1. Objectives

Defining agent-based systems is fraught with difficulty even in the rudimentary case of simple, reactive systems not involving explicit inter-agent communication. This task (of defining an agent-based system) consists of formulating the system architecture, the agent model (dynamics of internal state, of decision-making etc.), the model of the environment and its dynamics, and the reinforcement signal function. Using such a framework, we are interested in the study of reinforcement learning algorithms and stochastic planning.

3.2.2. Our approach : Markov decision processes and Reinforcement learning

An agent, as defined by Russell and Norvig [37], is anything that can be viewed as perceiving its environment through sensors and acting upon that environment through actuators". This view makes Markov decision processes (**MDPs**) a good candidate for formulating agents. It is probably why MDPs have received considerable attention in recent years by the artificial intelligence (AI) community. They have been adopted as a general framework for planning under uncertainty and reinforcement learning.

Formally, a Markov decision process is a four-tuple $\langle S, A, P, r \rangle$, where :

- S is the state space,
- A is the action space,
- P is the state-transition probability function that models the dynamics of the system. $P(s, a, s')$ is the probability of transitioning from s to s' given that action a is chosen.
- r is the reward function. $r(s, a, s')$ stands for the reward obtained from taking action a in state s, and transitioning to state s'.

With this framework, we can model the interaction between an agent and an environment. The environment can be considered as a Markov decision process which is controlled by an agent. When, in a given state s, an action a is chosen by the agent, the probability for the system to get to state s' is given by $P(s, a, s')$. After each transition, the environment generates a numerical reward $r(s, a, s')$. The behaviour of the agent can be represented by a mapping $\pi : S \rightarrow A$ between states and actions. Such a mapping is called a policy.

In such a framework, we consider the following problems:

1. Given the explicit knowledge of the problem (that is P and r), find an optimal behaviour, i.e the policy π which maximises a given performance criteria for the agent. There are three popular performance criteria to evaluate a policy:

   – expected reward to target,
   – discounted cumulative reward,
   – the average expected reward per stage.

2. Given the ability to interact with the environment (that is samples of P and r obtained by simulation or real-world interaction), find an optimal behaviour. This amounts to learning what to do in each state of the environment by a trial and error and such a problem is usually called reinforcement learning. It is, as stated by Sutton and Barto, an approach for understanding and automating goal-directed learning and decision-making that is quite different from supervised learning. Indeed, it is in most cases impossible to get examples of good behaviours for all situations in which an agent has to act. A trade-off between exploration and exploitation is one of the major issues to address.

3. Eventually, a general problem, which is useful for the two previous problems, consists in finding good representations of the environment so that an agent can achieve the above objectives.

In a more general case, an agent does not perceive the state in which he stands. The information that an agent can acquire on the environment is generally restricted to *observations* which only give partial information on the state of the system. These observations can be obtained for example using sensors that return some estimate of the state of the environment. Thus, the decision process has hidden state, and the issue of finding an optimal policy is no more a Markov problem. A model that describes such an hidden-state and observation structure is the **POMDP** (partially observable MDP). Formally, a POMDP is a tuple $\langle S, A, P, r, \Omega, O\rangle$ where

- S, A, P and r are defined as in an MDP.
- Ω is a finite set of observations.
- O is a table of observation probabilities. $O(s, a, s', o)$ is the probability of transitioning from s to s' on taking action a in s while observing o. Here s, $s' \in S$, $a \in A$, $o \in \Omega$.

Hidden Markov Models are a particular case of POMDP in which there is no action and no reward. Based on the mathematical framework, several learning algorithms can be used in dealing with Diagnosis and Prognosis tasks. Given a proper description of the *state* of a system, it is possible to model it as a Markov chain. The dynamics of the systems is modeled as *transition probabilities* between states. The information that an external observer of the system can acquire on it can be modeled using *observations* which only give partial information on the state of the system. The problem of diagnosis is then to find the most likely state given a sequence of observations. Prognosis is akin to predicting the future state of the system given a sequence of observation and, thus, is strongly linked to diagnosis in the case of Hidden Markov Model. Given a proper corpus of diagnosis examples, AI algorithms allow the automated learning of an appropriate Hidden Markov Model that can be used for both diagnosis and prognosis. Rabiner [36] gives an excellent introduction to HMM and describes the most frequently used algorithms.

While substantial progress has been made in planning and control of single agents, a similar formal treatment of multi-agent systems is still missing. Some preliminary work has been reported, but it generally avoids the central issue in multi-agent systems: agents typically have different information and different knowledge about the overall system and they cannot share all this information all the time. To address the problem of coordination and control of collaborative multi-agent systems, we are conducting both analytical and experimental research aimed at understanding the computational complexity of the problem and at developing effective algorithms for solving it. The main objectives of the project are:

- Develop a formal foundation for analysis, algorithm development, and evaluation of different approaches to the control of collaborative multi-agent systems that explicitly captures the notion of communication cost.
- Identify the complexity of the planning and control problem under various constraints on information observability and communication costs.
- Gain a better understanding of what makes decentralized planning and control a hard problem and how to simplify it without compromising the efficiency of the model.
- Develop new general-purpose algorithms for solving different classes of the decentralized planning and control problem.
- Demonstrate the applicability of the new techniques to realistic applications and develop evaluation metrics suitable for decentralized planning and control.

In formalizing coordination, we take an approach based on distributed optimization, in part because we feel that this is the richest such framework: it handles coordination problems in which there are multiple and concurrent goals of varying worth, hard and soft deadlines for goal achievement, alternative ways of achieving goals that offer a trade off between the quality of the solution and the resources required. Equally important is the fact that this decision-theoretic approach allows us to model explicitly the effects of environmental uncertainty, incomplete and uncertain information and action outcome uncertainty. Coping with these uncertainties is one of the key challenges in designing sophisticated coordination protocols. Finally, a decision-theoretic framework is the most natural one for quantifying the performance of coordination protocols from a statistical perspective.

3.2.3. *Contemporary similar or related work in national and international laboratories*

As far as stochastical planning is concerned, since the mid-1990s, models based on Markov decision processes (MDPs) have been increasingly used by the AI research community, and more and more researchers in this domain are now using MDPs. Our research group has participated (for instance, notably in co-organizing workshops of AAAI, IJCAI and ECAI in association with ARC INRIA LIRE and with Philippe Chassaing of the Omega project) and continues to participate in and contribute to the development of this domain through collaborations with Shlomo Zilberstein (on two NSF-INRIA projects) and with NASA (on a project entitled “Self-directed cooperative planetary rovers”) in association with Shlomo Zilberstein and Victor Lesser of the University of Massachussetts, Eric Hansen of the Mississippi State University, Richard Washington of the NASA Ames Research Centre and Abdel-illah Mouaddib of CRIL, Lens.

We have been using the strengths of the basic theoretical properties of the two major approaches for learning and planning that we follow, to design exact algorithms that are able to deal with practical problems of high complexity. Instances of these algorithms include the JLO algorithm for Bayesian networks, the Q-learning, TD(λ) and Witness algorithms for problems based on the Markov decision process formalism etc. While it is true that the majority of this work has been done in the United States, the French research community is catching up quickly by developing further this domain on its own. MAIA has been involved directly in making substantial contributions to this development, notably through our active participation in the (informally formed) group of French researchers working on MDPs. Thus, today there are quite a few research labs in France with teams working on MDPs. To name a few, Toulouse-based labs such as IRIT, CERT, INRA, LAAS etc, the Greyc at Caen, and certain Paris-based researchers such as Rémi Munos (Polytechnique) and Olivier Sigaud (Paris VI).

Most of the current work is focused on finding approximate algorithms. Besides applying these algorithms to a multi-agent system (MAS) framework, we have also been focusing on reducing the complexity of implementing these algorithms by making use of the meta-knowledge available in the system being modeled. Thus in implementing the algorithms, we seek temporal, spatial and structural dynamics or functions of the given problem. This is very time-effective in finding approximate solutions of the problem. Moreover, we are seeking ways to combine rigorously these two forms of learning, and to then use them for applications involving planning or learning for agents located in an environment.

3.3. The nature-inspired approach

3.3.1. Objectives

One of the research themes of the MAIA project is that of collective intelligence. Collective intelligence concerns the design of reactive multi-agent systems to collectively solve a problem. Reactive systems made up of simple-behavior agents with decentralized control that despite their individual simplicity are able to collectively solve problems whose complexity is beyond the scope of individuals: "intelligence" of the system can be envisaged as a collective property.

One of the difficulties in the design of reactive multi-agent systems is to specify simple interactions between agents and between them and their environment so as to make the society be able to fulfill its requirements with a reasonable efficiency. This difficulty is proportional to the distance between the simplicity of individuals and the complexity of the collective property.

We are interested in the design of such systems by the transposition of natural self-organized systems.

3.3.2. Approach

Reactive multi-agent systems are characterized by decentralized control (no agent has a knowledge of the whole system) and simple agents that have limited (possibly no) representation of themselves, of the others, and of the environment. Agent behaviors are based upon stimulus-response rules, decision-making is based on limited information about the environment and on limited internal states, and they do not refer to explicit deliberation.

Thus the collective observed complexity comes out of the individual simplicity and is the consequence of successive actions and interactions of agents through the environment. Such systems involve two levels of description: one for individual behavior (with no reference to the global phenomena) and one to express collective phenomena.

The design problem can be summarized as the two following questions:

1. Considering a global desired property or behavior, how to build individual behaviors and system dynamics in order to obtain it?
2. Considering a set of individual behaviors and a system dynamics, how to predict (or guarantee) the global property?

Such a methodology is still missing and we will contribute to this purpose. We organize our research in three part:

1. understanding collective intelligence by studying examples of such systems,
2. transposing principles found in example systems to solve problems, and
3. providing a framework to help analyse and formalize such systems.

- The first part is to model existing self-organized phenomena and thus have a better understanding of the underlying mechanisms. For instance, social phenomena in biology provide a lot of examples in which a collection of simple, situated entities (such as ants) can collectively exhibit complex properties which can be interpreted as a collective response to an environmental problem. We have worked with biologists and provided several models of self organized activities in case of spiders and rats.

- Since individual models and system dynamics are established, the second part consists of transposing them in order to solve a given problem. The transposition corresponds to encode the problem such as to be an input for the swarm mechanism; to adapt the swarm mechanism to the specificities of the problem, and if necessary to improve it for efficiency purpose; and then to interpret the collective result of the swarm mechanism as a solution of the problem.
- The third part aims at providing a framework to face the following issues:

    i. Is it possible to describe such mechanisms in order to easily adapt and reuse them for several different instances of the problem (*generic or formal description*)?

    ii. If such a generic description of a system is available, is it possible to assess the behaviour of the system in order to derive properties that will be conserved in its instantiations (*analyse and assessment of system*) ?

3.3.3. Related work in the national / international research community

Of the two principal approaches to the study of multi-agent systems (MAS), we have been inclined to adopt for our research, the approach of "collective" systems which emphasize the notions of interactions and organization. This is evident in the numerous collaborations that we have undertaken with researchers of this field as well as in the kinds of research groups we associate and work with:

- the AgentLink community in Europe, especially the one which is interested in self-organization, and
- the research group 'Colline' (under the aegis of GDR I3 and the AFIA) since 1997.

The approach that we have adopted for the design of multi-agent systems is based on the notion of self-organization, and it notably also includes the study of their emerging properties. Even if the research community working in this specific sub-domain is even smaller, it is a growing one, and it is developing interestingly, especially through the work being done at Iremia (at the University of Réunion), at IRIT, at LIRIS in Lyon, ...at LIRMM, etc, and in certain other laboratories of the UE (D. Van Parunak, R. Brooks for example) and Europe F. Zambonelli (University of Modena Italy), P. Marrow (British Telecom ICT Research Centre UK), G. Di Marzo Serugendo (University of Geneva Switzerland), etc.

Some of these researchers have taken inspiration from biological models to envisage the emerging properties. Principally, this current work is inspired by ant-colony models (such as at LIP6, at Lirmm in France or at the IRIDIA, Brussels). We consider the use of the models such as the spider colonies or the groups of rats as an original contribution from us toward this study, it having never been utilised before. It must be mentioned that this field has been influenced to a considerable extent by the work of Jean-Louis Deneubourg of CENOLI (Brussels) which concerns phenomena involving self-organization in such colonies and the mechanisms of interaction by pheronomes in ant-colonies.

4. Application Domains

In order to achieve its basic research program, the MAIA team has developed and is developing a strong known-how in sequential or distributed decision making. In particular, mathematical tools such as Markov decision processes, hidden Markov models or Bayesian Networks are appropriate and are used by the team for the development of real applications such as

- monitoring the hydration state of patients suffering from kidney disease
- elderly fall prevention
- infection skin prevention around the catheter used for peritoneal dialyses
- e-maintenance
- collaborative filtering
- ambient intelligence
- learning mediation strategies for heterogeneous agents cooperation.

5. Software

- Baiabox - It is a toolbox for developping bayésian networks applications.
- The Dialhemo project has the objective to develop a remote surveillance and telediagnosis system adapted to renal insufficiency patients treated by hemodialysis. The main objective is to insure people who are treated either at home, or in self-dialysis centers, the same level of secury as in hospital. A first software developped in cooperation with Diatelic Sa, Gambro and ALTIR is currently experimented in several sites. About 150 patients currently benefit of this first system.

6. New Results

6.1. Synopsis

6.1.1. The Formal approach

As explained earlier, one of MAIA's focus is the use of formal models such as Markov Decision Processes and its variants. Severe limitations on using this approach for designing agent based systems remains when:

- big size problems have to be addressed,
- problems are not markovian
- non stationary processes have to be addressed
- the environment, or actions are continuous
- behavior results from the interaction of independent decision makers (multi-agent systems)

The MAIA project has contributed this year to raise up some of this limitations. The contributions presented in the Multi-agent subsection [34][26][25][27][9][30][29][31] concerns the creation of behaviors for individual agents in a multi agent task requiring cooperation between agents. This work focuses on the development of a decision-theoretic framework for planning, learning and control of collaborative multi-agent systems by formalizing the problem as decentralized control of a Markov process. The overall goal is to develop sophisticated coordination strategies that stand on a formal footing. This enables us to better understand the strengths and limitations of existing heuristic approaches to coordination and, more importantly, to develop new approaches based on these more formal underpinnings. For that, We are extending the widely used Markov decision process (MDP) by separating the local state information available to each agent from the global information state. Sharing of information among agents is achieved through communication actions that may incur a cost.

The contributions [12][14][21][8][7] presented in the second subsection (Single agent formal models), adresses some of the other mentionned issues. In [12][14] the problem of generating the behavior of a single agent evolving in a complex environment is adressed. In contrast to the majority of recent work in RL, we have developped an approach on decomposing problems into sets of simultaneous tasks, instead of hierarchies of sequential subtasks. By breaking a problem up into concurrent, competing subtasks, the architecture of the agent itself takes on an MAS-like flavor. In [21] a preliminary work adresses the problem of dealing with continuous actions. Finaly in [8][7], we are concerned with the issues of dealing with very large state spaces.

6.1.2. The nature-inspired approach

As presented before, we structured our research in three main parts:

1. understanding collective intelligence by studying examples of such systems,
2. transposing principles found in example systems to solve problems, and
3. providing a framework to help to analyse and formalize such systems.

We contributed to the first part by obtaining a deeper understanding of the rat's model. The contribution [28] describes the main adaptive properties of that model.

The contribution [17][16][3][18] describe the application of a self-organized mechanism to a real problem in mobile robotics and the benefit of such an approach compared to traditional ones.

This year, we initiated new research activities in the third part by proposing the core principles of a platform to analyse self-organized systems and by achieving a first implementation of such a platform. This work is described in [11]. We also continued our work regarding the formalization of self-organized system [30][29][31]

6.2. Multi-agent formal models

6.2.1. Coordination through Mutual Notification in Cooperative Multiagent Reinforcement Learning

Participants: Daniel Szer, François Charpillet.

We present a new algorithm for cooperative reinforcement learning in multiagent systems. Our main concern is the correct coordination between the members of the team : We seek to obtain an optimal solution for the team as a whole while keeping the learning as decentralized as possible. We furthermore consider autonomous and independently learning agents that do not store any explicit information about their teammates' behavior. Reward functions may be different for each agent and coordination between agents occurs through communication, namely the mutual notification algorithm. We define the learning problem as a decentralized MDP, we then give an optimality criterion, and prove the convergence of the algorithm for deterministic environments. Finally we study the convergence properties and communication overhead on two small examples. [34][26][25][27]

6.2.2. Cooperation through communication in decentralized Markov games

Participants: Raghav Aras, Alain Dutech, François Charpillet.

In this work, we present a reinforcement-learning algorithm that integrates communication for a general-sum Markov game or MG played by independent, cooperative agents. The algorithm assumes that agents can communicate but do not know the purpose (the semantics) of doing so. We model agents that have different tasks, some of which may be commonly beneficial. The objective of the agents is to determine which are the commonly beneficial tasks, and learn a sequence of actions that achieves the common tasks. In other words, the agents play a multi-stage coordination game, of which they know neither the stage-wise payoff matrix nor the stage transition matrix. Our principal interest is in imposing realistic conditions of learning on the agents. Towards this end, we assume that they operate in a strictly imperfect monitoring setting wherein they do not observe one another's actions or rewards. A learning algorithm for a Markov game under this stricter condition of learning has not been proposed yet to our knowledge. We describe this Markov game with individual reward functions as a new formalism, decentralized Markov game or Dec-MG, a formalism borrowed from Dec-MDP (Markov decison process). For the communicatory aspect of the learning conditions, we propose a series of communication frameworks graduated in terms of facilitation of information exchange amongst the agents. We present results of testing our algorithm in a toy problem MG called a total guessing game. [9]

6.2.3. Interac-DEC-MDP : Towards the use of interactions in DEC-MDP

Participants: Vincent Thomas, Christine Bourjot, Vincent Chevrier.

We present a new formalism Interac-DEC-MDP whose aim is to introduce the concept of interaction in Decentralized Markov Decision Process and which has been inspired by biology. The aim of this formalism is to describe and represent homogeneously actions and direct interactions between agents. Thanks to the introduction of individual rewards characterising the problem to be solved, this formalism is a first step towards the automatic computation of policies and use of available interactions. The outcome of interactions is decided collectively by two agents and is in charge of the distribution of local rewards. We have modeled a biological experiment within this formalism. A simple learning algorithm applied on this formalism generates a more efficient collective behavior than without interactions. Moreover, a simple problem of distributing resources among 2 agents has been modelled and solved by a Qlearning based approach. First results show that it is possible to benefit from simple individual learnings to produce efficient collective behaviour. [30][29][31]

6.3. Single agent formal models

6.3.1. Self-Growth of Basic Behaviors in an Action Selection Based Agent

Participants: Olivier Buffet, Alain Dutech, François Charpillet.

We investigate on designing agents facing multiple objectives simultaneously, which creates difficult situations, even if each objective is of low complexity. The present work builds on an existing action selection process based on basic behaviors (resulting in a modular architecture) and proposes an algorithm for automatically selecting and learning the required basic behaviors through an incremental Reinforcement Learning approach. This leads to a very autonomous architecture, as the hand-coding is here reduced to its minimum [12][14].

6.3.2. Optimal Decision with Continuous Actions

Participants: Laurent Jeanpierre, Shlomo Zilberstein, François Charpillet.

In this work, we show an original method for solving decision problems with continuous actions. From a deterministic modelling of the problem with non-linear differential equations, we compute the value function based on an approximation by finite elements, which is known to converge to the optimal value. The elements to add are chosen by carefully solving the formal system of equations so that the optimal value could be attained with as few elements as possible [21].

6.3.3. Asynchronous Neurocomputing for optimal control and reinforcement learning with large state spaces

Participant: Bruno Scherrer.

We consider two machine learning related problems, optimal control and reinforcement learning. We show that, even when their state space is very large (possibly infinite), natural algorithmic solutions can be implemented in an asynchronous neurocomputing way, that is by an assembly of interconnected simple neuron-like units which does not require any synchronization. From a neuroscience perspective, this work might help understanding how an asynchronous assembly of simple units can give rise to efficient control. From a computational point of view, such neurocomputing architectures can exploit their massively parallel structure and be significantly faster than standard sequential approaches. The contributions of this work are the following: 1) We introduce a theoretically sound methodology for designing a whole class of asynchronous neurocomputing algorithms. 2) We build an original asynchronous neurocomputing architecture for optimal control in a small state space, then we show how to improve this architecture so that also solves the reinforcement learning problem. 3) Finally, we show how to extend this architecture to address the case where the state space is large (possibly infinite) by using an asynchronous neurocomputing adaptive approximation scheme. We illustrate this approximation scheme on two continuous space control problems [8][7].

6.3.4. Planning under uncertainty with multiple consumable resources

Participants: Simon Le Gloannec, Abdel-Illah Mouaddib, François Charpillet.

Most work on planning under uncertainty in AI assumes rather simple action models, which do not consider multiple resources. This assumption is not reasonable for many applications such as planetary rovers which must cope with uncertainty about the duration of tasks, the energy, and the data storage necessary. In this work, we outline an approach to control the operation of an autonomous rover which operates under multiple resource constraints. We consider a directed acyclic graph of progressive processing tasks with multiple resources, for which an optimal policy is obtained by solving a corresponding Markov Decision Process (MDP). Computing an optimal policy for an MDP with multiple resources makes the search space large. We cannot calculate this optimal policy at run-time. The approach developed in this work overcomes this difficulty by combining: decomposition of a large MDP into smaller ones, compression of the state space by exploiting characteristics of the multiple resources constraint, construction of local policies for the decomposed MDPs using state space discretization and resource compression, and recomposition of the local policies to obtain a near optimal global policy. Finally, we present first experimental results showing the feasibility and performances of our approach. [22]

6.4. Nature-inspired models

6.4.1. Hamelin : A model for collective adaptation based on internal stimuli

Participants: Vincent Thomas, Christine Bourjot, Vincent Chevrier, Dider Desor.

Groups of rats confronted to an increasing difficulty to reach food organize themselves. The emergent organizational structure is characterized by a distribution of two different behavioral profiles among the rats. This specialization is stable, robust and presents adaptive properties. Hamelin, the simulation system we propose is based on the coupling of two existing models : adaptive response thresholds and dominance relationships. It manages to reproduce the organization observed by biologists and presents some interesting adaptive properties. The originality of this model is that local internal needs (hunger) are distributed among the collectivity without an explicit global representation. The collectivity profits from individual adaptation abilities. [28]

6.4.2. Interac-DEC-MDP : Towards the use of interactions in DEC-MDP

Participants: Vincent Thomas, Christine Bourjot, Vincent Chevrier.

See section 6.2.3.

6.4.3. Localizing and Tracking Targets with a Reactive Multi-Agent System

Participants: Frank Gechter, Vincent Chevrier, François Charpillet.

Localization and Target-Tracking are both tough and widespread tasks in mobile robotics. The localization problem can be defined as the process to determine the position of an object within a reference coordinate system, whereas the tracking problem consists in constructing a trajectory based on a collection of spatially and temporally coherent localizations. We propose in this work a swarm approach for addressing these problems using an interaction paradigm inspired from physics. The combination of different inter-agent or agent-environment interactions such as attraction, repulsion, consumption and evaporation results in a self-organised process that builds patterns interpreted as solutions of the problem. Further works describe the core components of the model, the details of the interactions and propose analyses of the properties and performance of our device through experiments in simulation and with real robots considered as moving targets. In particular, a comparison with the standard Kalman filtering method demonstrates the relevancy of our approach. Moreover, it overpasses traditional ones concerning its robustness, adaptability, data fusion capabilities. [17][16][3][18]

6.4.4. A Platform for the analysis of artificial self-organized systems

Participants: Christine Bourjot, Vincent Chevrier.

The context of this work is that of systems being able to produce a collective response from interaction between simple individuals. Such self-organized systems can be modeled with reactive multi-agent systems.

This work underlines why, from our point of view, the analysis of these systems requires an experimental approach and provides motivation to that purpose. It explains the main components of such an experimental platform and presents a first implementation of these propositions. After commenting on each main component of the platform, it provides some details about its current implementation in the case of two systems. [11]

6.5. Applications

6.5.1. Application of Markov Decision Processes to the Frequency Assignment Problem

Participants: Jean-Yves Greff, Lhassane Idoumghar, René Schott.

This work presents an original algorithm, based on Markov Decision Processes, that is used to solve the frequency assignment problem in the field of radiobroadcasting. The results that are obtained by this algorithm are compared to the best known results obtained by hybrid genetic algorithms, ant colony paradigms and the best operating solution in the field of radiobroadcasting in France. [4]

6.5.2. Coordination in hSMA

Participants: Romaric Charton, Anne Boyer, François Charpillet.

This work deals with a prospective way to allow for communication between heterogeneous agents in the framework of multimedia services. The focus is set on the interaction between a user of a service and his/her virtual assistant. The interaction takes the form of a dialog and tries to identify the tasks that the current user wants to perform. The work gives a short description of dialog systems and proposes to adapt them to discover the goals the user wants to achieve. Our approach to monitor the dialog system relies on Markov Decision Processes, which are particularly suitable to handle uncertainty that occurs at many points of the communication. [33]

6.5.3. Interactive and Cooperative Monitoring applied to Peritoneal Dialysis Patients

Participants: Laurent Jeanpierre, François Charpillet.

Diatelic is in one of the first interactive and intelligent public telemedicine systems applied to the treatment and monitoring of dialysis patients. This system, resulting from the collaboration between LORIA and ALTIR (Lorrain Association for Renal Failure Treatments), was baptized DIATELIC (Interactive and Cooperative Monitoring of Dialysis Patients). In addition to optimising the transmission of data via intra/internet, the DIATELIC system has a diagnosis system designed to detect anomalies, which can appear progressively and imperceptibly. This system uses a system based on decision theory (Hidden Markov Model), which enables the interpretation using basic data (weight, blood pressure, differential blood pressure, orthostatic blood pressure, peritoneal ultra filtration, etc.). Based on such data the system triggers alarms based on thresholds, which are pre-established or calculated using the averages of the previous 15 days. The nephrologists can personalize the system by changing the patient profile to a certain extent. This can be done easily by telling the system when the diagnosis it provides is not relevant to the nephrologist' diagnosis. A learning procedure adapts the patient profile accordingly. The Diatelic system is now developed and maintained by a start up Diatelic SA, which is currently deploying the system for all people in Lorraine suffering from kidney disease and treated using peritoneal dialysis.

Several publications [5][19][20][32] have been published this year. The first one is a survey of the intelligent component of the system and it reports the main conclusions issued from a medical experimentation during two years. The two following ones detail some technical aspects of the system. And the last is a suvey of the project.

7. Other Grants and Activities

7.1. Regional initiatives Actions

7.1.1. MIBOCA

Participants: Christine Bourjot, Vincent Chevrier(project leader), Vincent Thomas.

This action is part of the PRST (Programme de Recherche Scientifique et Technique) "Software Intelligence" in the project TOAI (teleoperation and intelligent assistance). The aim of this action (called Biologically-Inspired Methods for the Organization of a Comunity of Assistants)is to study and implement one or more methods that enable a society of agents to organize themselves in a decentralized and dynamical manner. More precisely, we put this work in the context of swarm intelligence and propose to use a novel and original model we built in cooperation with biologists: the Hamelin model. Hamelin model reproduces a specialization phenomenon that can be observed in groups of rats [28]. This year, the work focused on a better understanding of the phenomenon. We specified and developed a platform to study such a system [11]. We also proposed a transposed model and applied it to a toy example of task allocation in the network domain. We developed a first prototype to assess the relevance of the approach and have shown that on specific instances of the allocation problem we can obtain a specialization of the agents and that the use of the self-organized model improves the efficiency of the system.

See section 6.2.3 and 6.4.4.

7.1.2. Telemedecine Action

Participants: Julien Thomas, Loic Pélissier, Jamal Semoune, François Charpillet, Anne Boyer, Amine Boumaza.

This action is part of the PRST (Programme de Recherche Scientifique et Technique) "Software Intelligence" in the project TOAI (teleoperation and intelligent assistance). The aim of this action is to develop a basic research program for telemedecine.

The focus of the this action consists in designing innovative "telemedicine" services such as remote monitoring of patients suffering from chronic diseases or assistance for elderly people at home. In particular the work is applied to kidney diseases people considering the different means of treatment : peritoneal dialysis (Diatelic and RNTS Depic projects), hemodialysis (Dialhemo project), kidney transplantation (transplantelic project). Concerning elderly people we are involved in the RNTS parachute project about fall risk detection.

7.1.3. Action with CardiaBase

Participants: Julien Thomas, François Charpillet.

The evolution of medical knowledge and the release of tighter regulatory guidelines demand more and more intensive controls of cardiac data to guarantee drugs safety, and notably assessing the ECG evolution of patients when under a new drug, quickly receiving alerts in case of severe ECG abnormalities,storing all the ECGs of a patient and tracking (comparing) any changes over time. CardiaBase, a small compagny located in Nancy, provides interpretation which are based on reading methods performed by trained cardiologists.

In this framework with CardiaBase, we examine the use of Hidden Markov Models for automatically segmenting an electrocardiogram waveform into its constituent waveform features.

7.2. National initiatives Actions

7.2.1. RNTS PROJECT PARAChute

Participants: Loic Pélissier, Jamal Semoune, François Charpillet, Anne Boyer, Amine Boumaza.

PARAChute is a RNTS project dedicated to the prevention off falls by elderly people. The partners involved in this project are either research departments (Université Technologique de Troyes or the MAIA team from Loria), medical institution (CHU Nancy-Brabois, Institut Régional de Réadaptation, Institut de Myologie de Paris, Laboratoire de Physiologie neuromusculaire) or industrial partners (ACDM Concept - Nancy-, Application Electronique de Champagne) with the endorsement of the Région Champagne Ardennes, Téfal, Association Française contre les Myopathies and the CCAS of Nancy.

Falls by elderly people are a major problem of health services because of their frequency and their medical and social consequences. In France, about two million people over sixty five year fall every year. Falls are responsible for an important morbidity (50 000 fractures of the thighbone upper extremity each year in France), a mortality evaluated to 13 000 deaths per year (more than the number of deaths due to road accidents). As falls are a major risk, it is a key challenge to design systems able to detect falls as fast as possible in order to alert the relevant assistance service. Our task in MAIA is to create a non-invasive monitoring of the elderly subject's locomotive behaviour in his/her environment in order to isolate parameters whose values will serve as an alert signal. Our approach of an intelligent monitoring for fall prevention is based on an ecological analysis of the walk. It will thus be a question of in-place walk's telemonitoring. MAIA is then working on the development of a behavioral model based on the observations made via camera. The modeling relies on a notion of signature (set of features caracterising the walk behaviour).

A first feasibility study was carried out in LORIA. About twenty people were filmed walking in a corridor by a single standard CCD camera with a fixed position. We used a standard algorithm for motion detection. From these data, we determined some indicators like the trajectory on the ground, the mean speed, the immediate speed, the acceleration, the height and the orientation of the person. This set of parameters, used as a first estimation of a signature, gave us encouraging results as for the precision and the reproducbility of the calculated parameters.

Recent links between image analysis and image synthesis show that many problems in image analysis can be addressed as optimization problems. These new trends lead the scientific community to introduce bio-inspired optimization techniques (ant algorithms, artificial evolution, swarm intelligence, social spiders ...) as problem solving methods for image analysis.

In the frame of the PARACHUTE project where the problem is to monitor a person's locomotive behavior, a new evolutionary approach will be used to extract a set of parameters that characterize the person's walk. Using a body model, the algorithm explores the parameter space in order to find the set of parameters that fits the observations in the images.

The project began on October 2003, with a two years duration. This year, it resulted in two publications [23][6].

7.2.2. RNTS DEPIC project

Participant: François Charpillet.

This project aims at designing a new sensor for the prevention of skin infection around the catheter used for peritoneal dialysis. The sensor is under design by the micro system team (André Dittmar and George Delhomme) of the Laboratoire de physique de la matière de l'INSA de Lyon. It consists of 19 temperature sensors put on a circle that is placed on the skin of the patient for a measure. The idea is that a particular signature could be characteristic of infection. Our team is involved in the interpretation of the signal delivered by the sensor.

This year, we developed an acquisition software which retrieves and displays the temperature readings from the hardware equipment, composed of a high precision temperature sensor and a ethernet multimeter. A visual diagnosis can be associated with the readings by selecting from a table of images the one that resembles the most to the patient skin. Another feature of the software is taking a picture of the patient skin using a webcam. Once the system is connected to internet the data can be synchronized with a distant database.

This software will be used by medical personnel and therefore was designed to be as easy to use as possible.

An acquisition campaign will take place at Nancy and Lyon in order to build a sufficient database for the analysis of the temperatures.

7.2.3. INRIA Development Action DialHémo : Telemedicine System for kidney disease Patients undergoing hemodialysis

Participants: Cédric Rose, Cherif Smaili, Jamal Semoune, François Charpillet, Anne Boyer (project leader).

The goal of this project is to develop a telemonitoring and diagnosis aid system for the patients undergoing continuous hémodialysis at home, or at the hospital. The input data to the system are returned by the dialysis machine (duration of the session, volume of blood) or by other sensors (weight, blood pressure). The results of data analysis will be available to nephrologists. Organisations which combine their efforts in the HemoDial project are : the research project MAIA at LORIA, the DIATELIC society, technology company stemming from LORIA, partners of the medical and health world in Lorraine (CHU de Nancy, ALTIR), the GAMBRO society, world leader on the market of dialysis machines.

The system intends to monitor the dry weight of the patient which is the weight a normally hydrated patient should have. An experimental platform developed this year by Diatelic by Diatelic SA, is used for acquiring and transmitting medical data to a database, making it accessible to physicians.

Maia team developed a first version of an expert system which analyses the evolution of pre and post dialysis blood pressure and body weight in order to produce a diagnosis of the dry weight and generate an alert when it is diagnosed as inappropriate for the patient. A dynamic bayesian network (DBN) is used to produce this diagnosis. Baysian networks algorithms have been implemented in a tool box which could be used for other projects.

Currently an evaluation of the system is being made by 150 patients treated with hemodialysis at the ALTIR (St Jacques unit) of the CHU of Brabois and at Gerarmer. The centres of Essey, Epinal, Mont Saint Martin and Metz are due to join the experimentation soon. A measurement of care quality is established by following the hypertension statistics among centres.

The first analysis of the care quality is promising. Alerts generated by the expert system are reliable and the diagnosis is most of the time in agreement with the physician decisions. Signals produced directly by the dialysis device, will be added to the expert system. It seems that some of these signals could help in anticipating the dry weight evolution. Currently we are evaluating the use of hemoscan, which measures blood volume variations during the dialysis.

7.2.4. PREDIT PROJECT MOBIVIP

Participants: Maan El Badaoui, El Nadjar, François Charpillet.

Intelligent Autonomous Vehicles currently hold the attention of many researchers because they can bring solutions to many applications related to transport of passengers in urban environments. An example of such a vehicle is the Cycab. The Mobivip project reach several goals in the domain of mobility services (www.inria.fr/mobivip). In the framework of Mobivip project, MAIA team search to play a part in the navigation and guidance system of the Cycab in his evolution environment.

Outdoor positioning and navigation systems often rely on road map database and GPS. However, GPS suffers from satellite masks occurring in urban environments, under bridges, tunnels or in forests. GPS appears then as an intermittently-available positioning system that needs to be backed up by other localization sensors. The MAIA team, and in order to obtain an accurate positioning and ameliorate position tracking process of the Cycab, propose to augment the road map database by a 3D model of the Cycab environment geo-localised (matched) on the digital road map. The accuracy of DGPS geo-localisation of the Cycab on the map database is not sufficient for autonomous navigation. The idea is to ameliorate the metric localization provided by such a system to centimetric localization accuracy by using the 3D model which have a centimeteric geo-accuracy. Sensors and information sources used for this task are GPS, inertial central, stereovision, Laser range sensor and road map database managed by a Geographical Information Sytem. The approach of position tracking under study at MAIA project is based on the use of Particle Filter and Extended Kalman Filter (El Najjar 2004, Gustafsson 2002) for multi-sensor fusion, Belief theory and Hidden Markov Model for Road Reduction Filter [35].

Actually, the Loria Cycab is under update phase at Robosoft Inc. This Cycab will be equipped by GPS/DGPS System, Inertial Central, Stereovision System and Two Laser Range Sensors (one in front and the second will be fixed at the right side of the Cycab).

7.3. European initiatives

7.3.1. TFG

Participants: Christine Bourjot, Vincent Chevrier.

MAIA is member of AgentLink that is the European Commission's IST-funded Coordination Action for Agent-Based Computing (http://www.agentlink.org). Vincent Chevrier is promoter of the Technical Forum

Group “Self Organization” in AgentLink (http://www.irit.fr/TFGSO/). The aim of the TFG is to work on self-organisation in the complex distributed systems such as Multi-agent systems.

7.3.2. The Ozone Project (IST-2000-30026)

Participant: Alain Dutech.

This project ended in 2004 with the specification and the implementation of many demonstrators. The MAIA team is more specifically involved in two demonstrators evolving around an electric automated Cybercar. In these demonstrators, users must interact with the Ozone system by the way of different modality and we are developing an intelligent Modality Advisor that select the best modality according to the user, the context, the quality of the media, the application, etc. Our work is based on stochastic methods with adaptive capabilities (throught learning) and, for comparison, rule based methods.

More specifically, we have investigated the use of Reinforcement Learning in a continuous domain (the preferences of the users). To keep the number of parameters manageable, we have decomposed the learning in two steps:

- Learning accurate preferences of an “average” user using nearest neighbour approximations of the value function.
- For each user, learning a parametrization of the “deviance from the average” using only very few parameters.

The learning process has been implemented in a prototype package that could not be tested on the demonstrator, but that was validated on corpuses of artificial data. It compared favorably with the actual rule-based package used on the demonstrator.

7.3.3. IST project ELIN(IST 2000-30188)

Participants: Régis Lhoste, Anne Boyer (WP1 leader).

The IST 2000-30188 project Elin (Electronic Newspaper)) gathers two media companies - Diari Segre from Spain and Corren from Sweden - and several organisations such as Alamo (Spain), FhG (Germany), FZI (Germany), LIU (Sweden), UPC (Spain) and INRIA through the MAIA research team. ELIN objective is to improve current electronic newspapers by enhancing consumer’s experience by introducing interactive features, advanced personalisation and ubiquity of use and by improve the productivity in the publishing chain by introducing better tools and practises on content authoring and management.

These objectives lead to the definition of the ELIN Architecture that defines the components of an advanced electronic newspaper and how these components interface each other. MAIA is in charge of the definition and the development of a smart agency based on a Jade Agent Platform to perform user adaptation through collaborative filtering. we have investigated the use of both explicit (choice of the user for example) and implicit (deduced from user’s actions such as navigational actions or storage actions) ratings to implement a collaborative filtering approach to suggest news items in a push mode. The key features of our filtering system are:

- Access to heterogeneous, distributed, and dynamic data sources, by a great number of users. The distributed architecture of jade is a guarantee to access to different databases even physically distributed over networks.
- different reasoning techniques and algorithms are competitive and selected in function of the context.

7.3.4. ITEA PROTEUS project

Participants: François Charpillet, Alain Dutech, Loic Pélissier.

The ambition of PROTEUS project, which reaches its final point in december 2004, was to engineer a change in the landscape of today's maintenance support tools. The aim of the project was to provide a fully integrated platform that is able to support any broad e-maintenance strategy. Maintenance is considered an integral part of global EAO policies (Enterprise Asset Optimisation) currently being implemented by a growing number of industrial organisations. Predictive maintenance requires the harmonious integration of:

- Continuous remote monitoring of equipment throughout its lifetime.
- Maintenance and Repair Operation (MRO) process management, grouping logistic actions to improve the efficiency of remote access to technical documentation and knowledge repositories, on-line use of modelling packages, decisionhelp tools and human experts.
- Comprehensive data presentation and synthesis involving direct delivery of operational information, including supervisory and decision level, asset management panel and maintenance contract management.

MAIA was deeply involved in the projet, F. Charpillet and A. Dutech co-leading the workpackage two dealing with "the use of AI in computer assisted maintenance". After an evaluation of the adequacy of several AI tools to the task, the workpackage ficussed on the diagnosis/prognosis problem. In particular, following the specification elaborated within the workpackage, MAIA designed a PROTEUS web service relying on Hidden Markov Models for generic diagnosis. Publications and deliverables of the workpackage can be found on the web site of the PROTEUS project http://www.proteus-iteaproject.com/index.php?p=publications.

This year, this project resulted in two publication [15][24].

7.3.5. ESA SAT-n-SURF project

Participants: François Charpillet, Anne Boyer, Sylvain Castagnos.

The Sat-n-surf project comes within the scope of a collaboration between LORIA Laboratory (teams MAIA, Cortex and Orpailleur), the research center Henri Tudor and the company - from Luxembourg - of broadcasting per satellite ASTRA. The latter have finalized a system sponsored by advertisement and supplying to users a high bandwidth access to hundreds of web sites for free. This project aims at include a collaborative filtering in the architecture of their product. The term of collaborative filtering denotes techniques using the known tastes of a group of users to predict the unknown preference of a new user. The distinctive feature of current collaborative filtering processes is to be centralized. The scientific problems consist in finding a way to distribute calculi, in order to provide scale for several hundreds thousands of people, or then to preserve anonymity of users (personal data remain on client side). The impact of a model combining several existing methods to share out tasks between the server and users terminals has been examined in an article submitted to UM2005 and MFI2005.

Moreover, the distribution of calculi will allow ASTRA to bypass the United States patent number 5,790,935 defining how to do centralized collaborative filtering within the context of transmission per satellite.

The work has been centred like this :

- We have had in a first time to get used to filtering methods (work done during the master degree of Sylvain Castagnos). A detailed state-of-the-art of existing filtering and classification processes has been done. These algorithms are necessary to conception of a relevant recommendations toll based on predictions ;
- The second phase has consisted in defining a distributed model answering to imperatives of the company ASTRA. We have had consequently to make an inventory of constraints, functionalities to develop and valuation criteria of model. The partnership with ASTRA will allow to use data of their base and to carry out life-sized tests to verify the efficiency of proposed solutions (work of doctorate).

7.4. International initiatives

7.4.1. Self-Directed Cooperative Planetary Rovers : project sponsored by NASA Aerospace Technology Enterprise

Participant: François Charpillet.

This project includes partners from University of Massachusetts, Nasa, LORIA and GREYC. Planetary rovers are unmanned vehicles equipped with cameras and a variety of scientific sensors. They have proved to be a cost-effective mechanism in space exploration and will continue to play a major role in future NASA missions. Recent rover missions, such as Sojourner's Mars exploration, have suffered from total reliance on ground-based commanding and employed on-board autonomy only to safely follow uplinked commands. The inherent uncertainty that characterizes exploration of new environments and the limited communication bandwidth and time delays increase the risk of execution failures and rover downtime.

This project focuses on the question of how to best utilize the rover's resources in the face of the above difficulties. Our approach is to equip the rovers with pre-compiled control polices for making fast decisions on such issues as: how to best perform a given task given a set of alternatives; when the quality of the result is satisfactory; how to react to failure; how many times to retry to perform a certain operation; and how to best allocate limited resources to the entire set of activities over a certain window of operation.

To achieve these goals we are developing and evaluating several fundamental technologies, focused on the basic need to carefully manage the limited computational resources, power, and communication capabilities of the rover. First, we are enriching the rover plan language to describe different methods to achieve each sub-goal and the associated costs and expected quality. We are also providing the system with a model of the uncertainty about the outcome of actions and the resources they consume.

7.4.2. Developing a decision-theoretic framework for planning and control of collaborative multi-agent systems : INRIA associated team

Over the past years, a very fruitful research collaboration has been established between the MAIA group at INRIA, directed by François Charpillet, and the RBR group at the University of Massachusetts, directed by Shlomo Zilberstein. The collaboration was conceived at a meeting that took place in 1995 at the International Joint Conference on Artificial Intelligence in Montreal. During this meeting, we identified a high degree of overlap between our interests, research projects, and solution techniques. These common interests relate to the development of planning and monitoring techniques for autonomous systems that can operate in real-time and can cope with uncertainty and limited computational resources. At the time, the U.S. team investigated a solution technique based on "anytime algorithms" and the French team investigated the "progressive processing" model.

Since then, we have worked together on both of these models and exploited the synergy to improve their applicability and effectiveness. This year this collaboration has been funded by INRIA as an associated team. This association of the two research teams has focused on the development of a decision-theoretic framework for planning and control of collaborative multi-agent systems by formalizing the problem as decentralized control of a Markov process. The overall goal is to develop sophisticated coordination strategies that stand on a formal footing. This enables us to better understand the strengths and limitations of existing heuristic approaches to coordination and, more importantly, to develop new approaches based on these more formal underpinnings. There is a wide range of application domains in which decision-making must be performed by a number of distributed agents that are trying to achieve a common goal. This includes information-gathering agents, distributed sensing, coordination of multiple distributed robots, decentralized control of a power grid, autonomous space exploration systems, as well as the operation of complex human organizations. These domains require the development of a strategy for each decision maker assuming that decision makers will have limited ability to communicate when they execute their strategies, and therefore will have different knowledge about the global situation.

8. Dissemination

8.1. Visits, national and international relations

Maia is a leading force in the PDMIA group (Processus Decisionnels de Markov et Intelligence Artificielle) and took a great part in the annual meeting of the group. This year, the group held its annual meeting in Paris. This meeting took the form of a very informal workshop with scientific presentations and many open discussions. The most interesting talks and presentation are in the process of being compiled into a special issue of the french electronic journal JEDAI.

Maia members visited Leslie Kaelbling's team at the Computer Science and Artificial Intelligence Lab of the MIT, the associated team from the University of Massachusetts, and the DAMAS group from Laval university at Quebec.

MAIA is member of AgentLink that is the European Commission's IST-funded Coordination Action for Agent-Based Computing (http://www.agentlink.org).

8.2. Conference, workshop, PHD and HDR committees, invited conferences

- François Charpillet is a member of the committee of the RTP 11: Information et intelligence: "raisonner et décider" of the STIC department at CNRS.
- Anne Boyer, Vincent Chevrier and François Charpillet are member of several Specialiste Committees(commissions de spécialiste) respectively in Nancy2 and Strasbourg, Nancy 1, Paris 13.
- François Charpillet and Shlomo Zilberstein organized at Nancy a two-day Workshop. During this workshop, participants presented and discussed 12 presentations. Interaction between participants was a key factor contributing to the success of the workshop, which concluded with a broad open discussion. Participants agreed that another session of the workshop should be organised within next years.
- F. Charpillet was member of the following program committees :
  - the third international joint conference on Autonomous agents and Multi-agent systems, Columbia University in New York City, July 19-23, 2004.
  - Journées Francophones sur les Systèmes Multi-Agents, Paris, November 24-26, 2004.
  - The 2004 IEEE International Conference on Information Reuse and Integration (IEEE IRI-2004), November 8-10, Las Vegas, Nevada, USA
- F. Charpillet was a reviewer of the 2004 IEEE Mechatronics & Robotics, Aachen, Germany
- F. Charpillet was member/reviewer in the following Phd Committees:
  - Solange Lemai-Chenevier, "IXTET-EXEC : Planification, réparation de plan et contrôle d'exécution avec gestion du temps et des ressources", Laas, Toulouse
  - Laurent Péret, "Recherche en ligne pour les Processus Décisionnels de Markov : application à la maintenance d'une constellation de satellites", INRA, Toulouse
  - Joseph Zalatek, "Planification dans des structures complexes", IRIT, Toulouse
  - Mohamed Hariti, "Une méthode rapide d'appariement d'images stéréoscopiques : application à la perception de l'environnement d'un véhicule routier", UTBM, Belfort
  - Jean-Pierre Georgé, "Résolution de problèmes par émergence : o Etude d'un environnement de programmation émergente", IRIT, Toulouse

- F. Charpillet was member and reviewer in the following Habiliation Committees:
  - Frédérick Garcia, "Autour de l'action planifiée en environnement incertain", INRA, Toulouse
  - Olivier Sigaud, "Comportements adaptatifs pour les agents dans des environnements informatiques complexes", LIP6, Paris
- F. Charpillet was member of the following Habiliation Committees as a research director : Anne Boyer, "Du verbe à l'action : récit d'un parcours en IA", Loria, Nancy.
- F. Charpillet was member of the following Habilitation Committees as examiner member :
  - Marie-Pierre Gliezes, "Vers la résolution de problèmes par émergence", IRIT, Toulouse.
  - Emannuel Piat, "Contribution à la microrobotique en milieu liquide et à la commande par apprentissage par renforcement", LAB, Besançon.
- Alain Dutech and François Charpillet were reviewers for the French journal RIA.
- Olivier Buffet was a reviewer for the journal Computational Intelligence. He has since also been a reviewer for the French journals JEDAI and RIA.
- Vincent Chevrier was an invited speaker at Engineering Societies in Agent World (ESAW04), Toulouse, in October.
- Vincent Chevrier was a reviewer of JFSMA04 (Journée Francophones sur les systèmes mulit-agents) and was the chair of demonstrations session at JFSMA04
- François Charpillet and Vincent Chevrier are members of the steering committee of the research theme 'TeleOperation and Intelligent Assistant' in the PRST 'Software Intelligence'.
- Vincent Chevrier is a member of the Laboratory Council, of the editorial board of Interstices, a site to disseminate research work about computer science for french-speaking people, of the editorial board of the collection 'Exposés scientifiques multimedia' of INRIA, and of the editorial board of the "Lettre du LORIA", as well as the moderator of the mailing list of the french-speakers' community on multi-agent systems.
- Christine Bourjot and Vincent Chevrier are members of the working group 'Colline' (AFIA, GDR I3).
- Christine Bourjot is a member of the scientific council of "réseau grand Est des sciences cognitives"
- Christine Bourjot is a member of the pedagogical board of the Master's SIC and in charge of the speciality 'Cognitive Sciences pro'.
- Anne Boyer is chargée de mission auprès du président de l'université Nancy 2 on Information system.

8.3. Award

Daniel Szer and François Charpillet received the second AFIA award for their paper presented during the “Journées Francophones sur les Systèmes Multi-Agents” - JFSMA’04, Paris, France [25].

8.4. Popularization activity

8.4.1. The strategy of spiders

Participants: Vincent Chevrier, Dominique Chouchan.

This work concerns the dissemination of research results to non specialists. It concerns the multi-agent based modeling and simulation of web weaving in social spider species. The article presents the collaboration we had with biologists and the problem they were confronted with. It explains the principles of the multi-agent model and how they have been applied in the case of social spiders. The article is accessible on line at http://interstices.info [2].

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