INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET EN AUTOMATIQUE

Project-Team oasis

Objets Actifs, Sémantique, Internet et Sécurité

Sophia Antipolis

THEME 2A

Activity Report

2003

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1. Team

OASIS *is a joint project with CNRS I3S and University of Nice Sophia Antipolis.*

Head of project-team
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Vice-head of project team
Bernard Serpette [CR]

Administrative assistant
Claire Senica [TR]

Staff members (INRIA)
Éric Madelaine [CR]
Didier Parigot [CR, to 31/08/2003]

Staff members (UNSA)
Françoise Baude [MCF]
Denis Caromel [Professor, IUF member]

Technical staff
Matthieu Morel [ProActive, Arcad to 30/06/2003, then Osmose from 01/10/2003]
Romain Quilici [ProActive ODL]

Ph. D. students
Laurent Baduel [MESR/monitor UNSA/INRIA, from 01/09/2001]
Tomas Barros [Conicyt Chile/INRIA, from 01/10/2002]
Rabéa Boulifa [INRIA, from 01/10/2001]
Javier Bustos [Conicyt Chile/CNOUS/INRIA, from le 01/09/2003]
Arnaud Contes [DGA, from 01/11/2001]
Christian Delbé [MENRT/INRIA, from 01/10/2003]
Alexandre Genoud [MENRT/INRIA, from 01/10/2002]
Ludovic Henrio [DGA, to 31/08/2003, then Teaching Assistant from 01/09/2003]
Felipe Luna del Aquila [Conacyt Mexico/Sfere/INRIA, from 01/11/2002]
Emmanuel Reuter [Engineer IUFM Nice, from 01/11/2000]

Post-doctoral fellows
Éric Courdarcher [INRIA, from 01/09/2003]
Fabrice Huet [Teaching Assistant to 31/08/2003, then CWI, Amsterdam on an INRIA postdoc position, from 01/09/2003]
Julien Vayssiere [INRIA Industrial postdoc at SAP Labs, to 30/11/2003]

Visiting Scientists
Luis Mateu [Assistant Professor, University of Chile from 02/04/2003 to 30/09/2003]
José Piquer [Professor, University of Chile from 19/05/2003 to 23/05/2003]
Eric Tanter [PhD Student, University of Chile, from 04/01/2003 to 26/01/2003, then from 04/09/2003 to 15/09/2003]

Student interns
Benjamin Bannier [DESS Telecom UNSA, from 18/11/02 to 30/09/03]
Julien Baudry [DEA Troyes University, from 03/03/03 to 15/08/03]
Sébastien Claude [DESS Telecom UNSA, from 18/11/03 to 30/09/03]
Christian Delbe [DEA RSD UNSA, from 01/03/03 to 30/09/03]
Alexandre Di Costanzo [Master Munich-UNSA from 01/07/03 to 30/09/03]
Daniele Di Felice [Master Aquila University, from 08/09/03 to 15/12/03]
Nicolas Fiquet [ESC Toulon, from 25/06/03 to 30/09/03]

Jérôme Gahide [DESS ISI UNSA, from 13/10/03 to 02/04/04]
Nicolas Gama [ENS Lyon, from 02/06/03 to 30/08/03]
Vincent Garcia [ESSI UNSA, from 14/10/02 to 11/04/03]
Raphaël Gervaise [ESSI UNSA, from 14/10/02 to 11/04/03]
Laure Grillo [DESS ISI UNSA from 13/10/03 to 02/04/04]
Sébastien Kotzine [ESSI UNSA, from 14/10/02 to 11/04/03]
Guillermo Lama [Chile University, from 29/01/03 to 24/04/03]
Christophe Massol [MIAGE UNSA, from 01/03/03 to 31/08/03]
Katia Pijarowski [DESS Telecom UNSA, from 18/11/03 to 30/09/03]
Matthieu Recouly [ESSI UNSA, from 14/10/02 to 11/04/03]
Doru Rotovei [DEA Informatique UNSA, from 01/03/03 to 31/07/03]
Benoît Sedoni [DESS ISI UNSA from 13/10/03 to 02/04/04]
Jonathan Streit [Technical University (TU) of Munich, from 10/02/03 to 30/06/03]
Eric Tuilier [ESC Montpellier, from 23/06/03 to 30/09/03]
Santosh Anand [DEA RSD UNSA, from 07/11/03 to 30/09/04]
Alejandro Vera [Chile University, from 15/12/03 to 15/03/04]
Julien Viano [ESSI UNSA, from 14/10/02 to 11/04/03]

2. Overall Objectives

The team has now focused its activities on distributed computing and more specifically on the development of secure and reliable distributed systems using distributed asynchronous object systems (active objects - OA of OASIS). From this central point of focus, other research fields are considered in the project:

- Semantics (first S of OASIS): formal specification of active objects with the definition of ASP (Asynchronous Sequential Processes) and the study of precondition where this calculus becomes deterministic.
- Internet (I of OASIS): Grid computing with distributed and hierarchical components.
- Security (last S of OASIS): analysis and verification of programs written in such asynchronous models.

With these objectives, our approach is:

- theoretical: we study and define models and object-oriented languages (semantical definitions, equivalences, analyses);
- applied: we start from concrete and current problems, for which we propose technical solutions;
- pragmatic: we validate the models and solutions with full-scale experiments.

Internet clearly changed the sense of notions like mobility and security. We believe that we have the skills to be significantly fruitful in this major application domain; more specifically, we aim at producing interesting results for embedded applications for mobile users, Grid computing, peer-to-peer intranet, electronic trade and collaborative applications.

3. Scientific Foundations

3.1. Object distributed computation

The paradigm of object-oriented programming, although not very recent, got a second youth with the Java language. The concept of object, even universal as intended is clearly not properly defined and implemented: thus notions like inheritance, sub-typing or overloading have as many definitions as there are underlying languages. The introduction of concurrency into objects also increases the complexity. It appeared that, standard Java components such as RMI (Remote Method Invocation) do not help to build in a transparent way sequential, multi-threaded, or distributed applications, by allowing the execution of the same application on a shared-memory multiprocessors architecture as well as on a network of workstations (intranet, Internet), or on any hierarchical combination of both.

The question is thus: how to ease the construction, deployment and evolution of distributed applications ?

We have developed competencies in both theoretical and pragmatic fields, such as an asynchronous calculus with specific properties, automatic distribution of activities using static analysis, and the building of a Java library for parallel, distributed, and concurrent computing.

3.2. Static analysis and verification

Programming distributed objects, even with the help of high-level libraries, also increases the difficulty of analyzing their behaviors, and ensuring safety, security, or liveness properties of these applications.

More generally, the formal verification of software systems is an area more recent and more difficult than verification of hardware and circuits. This is true both at a theoretical and pragmatic levels, from the definition of adequate models representing programs, the mastering of state complexity through abstraction techniques or through new algorithmic approaches, to the design of software tools that will hide to the final user the complexity of the underlying theory.

Our approach is to use techniques of static analysis and abstract interpretation to extract finite models from the code of distributed applications. We will use then generic tools for checking properties of this model [8]. We concentrate on behavioral properties, expressed in terms of temporal logics (safety, liveness), of security, of adequacy of an implementation to its specification and of correct composition of software components.

4. Application Domains

4.1. Electronic business

Key words: *telecommunications*, *security*, *formal methods*, *proofs*, *program analysis*.

By electronic business, we mean distributed applications over the Internet that require safety and security otherwise they would not exist at all, due to highest risks (confidentiality, privacy, integrity, authentication and availability should be guaranteed).

We give examples of such applications:

- Secure commercial trade: programming such applications distributed over networks may uncover very complex behaviors, that may lead to deadlocks, starvation, and many other kinds of reachability or liveness problems. It is then necessary to propose methods for specifying the application behavior (requirements), and tools to check the implementation against those requirements. On the other hand, protection of communications and data are a requirement for the development of commercial applications. These security requirements have to be expressed in a security policy agreed by all partners, including customers.
- Secure collaborative applications: a multi-site enterprise may want to use Internet for the communication between different services and the collaborative building of a particular task, leading to specific problems of election, synchronization, load balancing, etc.
- Mobility for enterprise applications: a mobile worker should be able to run enterprise applications from anywhere, using heterogeneous network, and any device (desktop, labtop, PDA, board computer) in a transparent and a secure manner.

4.2. Grid computing

Key words: *Telecommunications*, *Grid*, *peer-to-peer*, *group communication*, *mobile object systems*, *fault tolerance*, *distribution*, *security*, *synchronization* .

As distributed systems are becoming ubiquitous, Grid computing is emerging as one of the major challenge for computer science: seamless access and use of large-scale computing resources, world-wide. The word "Grid" is chosen by analogy with the electric power grid, which provides pervasive access to power and, like the computer and a small number of other advances, has had a dramatic impact on human capabilities and society. It is believed that by providing pervasive, dependable, consistent and inexpensive access to advanced computational capabilities, computational grids will have a similar transforming effect, allowing new classes of applications to emerge.

Another challenge is how to use for a specific computation, unused CPU cycles of desktop computers in an Local Area Network. This is intranet Computational Peer-To-Peer.

There is a need for models and infrastructures for grid and peer-to-peer computing, and we promote a programming model based on communicating and mobile objects and components.

Another related domain of application is to use mobile objects for system and network management.

5. Software

5.1. ProActive

ProActive is a Java library (Source code under LGPL license) for parallel, distributed, and concurrent computing, also featuring mobility and security in a uniform framework. With a reduced set of simple primitives, ProActive provides a comprehensive API allowing to simplify the programming of applications that are distributed on Local Area Network (LAN), on cluster of workstations, or on Internet Grids.

The library is based on an Active Object pattern that is a uniform way to encapsulate:

- a remotely accessible object,
- a thread as an asynchronous activity,
- an actor with its own script,
- a server of incoming requests,
- a mobile and potentially secure agent.

ProActive is only made of standard Java classes, and requires **no changes to the Java Virtual Machine**, no preprocessing or compiler modification; programmers write standard Java code. Based on a simple Meta-Object Protocol (into which a security framework has been defined [13]), the library is itself extensible, making the system open for adaptations and optimizations. ProActive currently uses the RMI Java standard library as a portable transport layer. It incorporates new techniques so as to make functional exceptions come back to the calling object [21] (not only classical RMI exceptions).

ProActive is particularly well-adapted for the development of distributed applications over the Internet, thanks to reuse of sequential code, trough polymorphism, automatic future-based synchronizations, migration of activities from one virtual machine to another. The underlying programming model is thus innovative compared to, for instance, the well established MPI programming model [34].

Two important scientific and technical achievements in this context have successfully yield to an industrial protection:

- A patent on the various localization mechanisms in presence of active object migrations has been issued [31].
- Also, a patent on the automatic continuation mechanism (the retransmission of a future object as a parameter to a subsequent remote method call) has been applied [35].

An important new achievement (see 6.2) which further increases code reuse and opens a wide range of applications, is the design and implementation of a component-oriented model within the ProActive platform.

We have demonstrated on a set of applications the advantages of the ProActive library, and among other we are particularly proud of:

- Jem3D, an electromagnetism application using ProActive to deploy concurrent and parallel computation tasks on a large cluster of machines
- Desktop to Laptop to PDA, a wireless application based on ProActive

A graphical interface, IC2D http://www-sop.inria.fr/oasis/proactive/IC2D/, [3], allows the remote monitoring and steering of distributed applications. IC2D is a graphical environment for remote monitoring and steering of distributed and meta-computing applications. IC2D features graphical visualization and drag and drop migration of remote objects. As it is being interfaced with Jini and Globus, it can also serve as a building block for meta-computing and computing portals. IC2D is built on top of RMI and ProActive that provides asynchronous calls and migration.

ProActive is a project of the ObjectWeb Consortium. ObjectWeb is an international consortium fostering the development of open-source middle-ware for cutting-edge applications: EAI, e-business, clustering, grid computing, managed services and more (see http://www.objectweb.org). For more information, refer to [7] and to the web page http://www.inria.fr/oasis/proactive.

5.2. Bigloo's back-ends

Our work on Bigloo's back-end , in collaboration with Manuel Serrano of the Mimosa project, is integrated in the Bigloo compiler (http://www-sop.inria.fr/mimosa/fp/Bigloo/).

6. New Results

6.1. ASP: Asynchronous Sequential Processes

Participant: Denis Caromel, Ludovic Henrio, Bernard Serpette.

The objective of ASP is to design an object calculus that allows one to write parallel and distributed applications, particularly on wide range networks, while ensuring good properties.

The main characteristics of ASP are:

- asynchronous communications,
- futures,
- sequential execution within each process,
- simple preconditions where strong confluence and determinism properties can be proved.

A first design decision is the absence of sharing: objects live in disjoint activities. An activity is a set of objects managed by a unique process and a unique active object. Active objects are accessible through global/distant references. They communicate through asynchronous method calls with futures. A future is a global reference representing a result not yet computed. Our main result consists in a confluence property and its application to the identification of a set of programs behaving deterministically.

From a practical point of view, ASP can also be considered as a model of the ProActive library.

All ASP results can be found in Henrio's thesis [12] and the articles [30] and [22]

6.2. Hierarchical grid components

Participant: Françoise Baude, Denis Caromel, Matthieu Morel, Romain Quilici.

We propose a parallel and distributed component framework for building Grid applications, adapted to the hierarchical, highly distributed, highly heterogeneous nature of Grids. We have enriched ProActive by extending and implementing an existing hierarchical and dynamic component model, named Fractal, so as to master the complexity of composition, deployment, re-usability, and efficiency of grid applications. This defines a concept of Grid components, that can be parallel, made of several activities, and distributed. These components communicate using typed one-to-one or collective invocations [16].

This component model is defined and implemented within ProActive, see [17] [25]. This work is part of a very active research area which aims at easing grid programming by introducing powerful but efficient programming component-based models (see for instance a general presentation of this arena : [24] and [23]).

Further work is now to extend the IC2D tool so as to add interactive aspects related to components: composition, deployment, and dynamic rebinding and redeployment.

6.3. Fault Tolerance for Grid applications

Participant: Françoise Baude, Denis Caromel, Christian Delbé, Ludovic Henrio.

We have launched a PhD thesis on the very challenging following subject, which is undoubtedly critical for grid computing: fault tolerance of distributed object-oriented based applications running on a grid. Despite the number of checkpointing protocols developed for thirty years, there is none, to our knowledge, that is adapted to the following property: the non-preemptibility of processes. This property is however intrinsic to many environments like the Java platform, and appears in lots of middle-wares.

We offer, within the framework of an active objects model, an hybrid protocol combining communication induced checkpointing and message logging techniques, which is adapted to the non-preemptibility of processes. This protocol ensures strong consistency of recovery lines, and enables a fully asynchronous recovery of the distributed system after a failure (see [36]).

6.4. Securisation of object oriented applications

Participant: Isabelle Attali, Denis Caromel, Arnaud Contes, Felipe Luna del Aquila.

Grid applications must be able to cope with large variations in deployment: from intra-domain to multiple domains, going over private, to virtually-private, to public networks. As a consequence, the security should not be tied up in the application code, but rather easily configurable in a flexible, and abstract manner. Moreover, any large scale Grid application using hundreds or thousands of nodes will have to cope with migration of computations, for the sake of load balancing, change in resource availability, or just node failures. To cope with those issues, we propose a high-level and declarative security framework for object-oriented Grid applications. We define in a rather abstract manner, a hierarchical policy based on various entities (domain, host, JVM, activity, communication, ...) in a way that is compatible with a given deployment. The framework also accounts for open and collaborative applications, multiple principles with dynamic negotiation of security attributes and mobility of computations. This application-level security relies on a Public Key Infrastructure (PKI).

This security model is implemented within ProActive, see [14].

We are also interested in security problems found when information flows in object-based applications meant to be shared and distributed. The security problems are briefly stated to be the existence of unauthorized flows (or disclosure of information) and information leakages (existence of covert channel).

Our main contribution is to propose safe information flows by means of specification of the authorized information flowing through objects and its associated dynamic control.

Safe information flows imply secure information paths between the users of such applications and some computer resource. For this, secure paths require: (1) transmissions where data transfers are not limited to only obscure the data but to provide confidentiality (obscuring/encrypting data does not guarantees confidentiality), and (2) avoid the possible creation of covert channels.

6.5. Analysis and Verification Environment for Distributed Java

Participant: Isabelle Attali, Tomas Barros, Rabéa Boulifa, Javier Bustos, Denis Caromel, Ludovic Henrio, Éric Madelaine, Christophe Massol, Alejandro Vera.

We develop methods and tools for the automatic verification of behavioral properties of distributed applications. We are interested by temporal properties concerning the message exchanges between distributed components, in particular safety properties (deadlock, reachability, ordering of events) or liveness, and conformance (of a component interface, of the global application) to a specification. Some kind of security properties (access to resources, confidentiality) can also be treated with similar techniques.

We study methods for the generation of finite models for ProActive distributed applications, based on static analysis techniques [18]. These models will then be used by existing model-checking and equivalence-checking tools.

This work starts with the definition of a new behavioral semantics (by Rabea Boulifa), that highlights the communication events between remote objects. Given a finite abstraction of the data we need to observe in this communication, and of the active object creation, the model construction is guaranteed to terminate. The result is a hierarchical labeled transition system, that is adequate for compositional verification by bisimulation-based tools [19].

Tomas Barros has completed the case-study specifying the Chile electronic billing and VAT system [29], that has provided us with new insights on the parametric representation of our finite models. He has build a prototype tool that allows to expand a parametric model into a standard hierarchical LTS model, for a given valuation of the parameters. This tool allows real-size experiments for the verification of properties of parameterized systems.

We have started experimenting on the integration of existing static analysis techniques with our ProActive semantics, as a first exploratory phase in the construction of the Vercors verification platform (http://www-sop.inria.fr/oasis/Vercors). This was the work of Christophe Massols [37] also presented at the Modocop meeting in September. The tools integrate the front-end static analysis modules of Soot, the graphical interface of Bandera, a link with the Reqs solver, and implements the specificities required for analyzing a ProActive code. This work has allowed us to identify clearly the difficulties remaining in the static analysis layer of Vercors.

6.6. Static Analysis

Participant: Denis Caromel, Ludovic Henrio, Bernard Serpette.

Our work on implementation and complexity of the Lowest Static Reduction ends up on a publication [27].

This year we have taken some energy to clean up the Bigloo's back-ends. In 2000/2001 we have launch the JVM code generation, in 2002 we have started the .NET back-end, in 2003 we have decided to make a bench of common analysis before all code generation (currently C, JVM and .NET). All these analyses are done in a relatively independent, common RTL format (*Register Transfer Language*). This work will be useful each time a new target machine will be in consideration. This common back-end currently consists of 2200 lines of Scheme code. With this module the new JVM code generation has 2600 lines of code (against 5700 in the previous version) and the .Net code generation has 2000 lines (against 5700). All these works are done in collaboration with Manuel Serrano of the Mimosa project.

7. Contracts and Grants with Industry

7.1. ARCAD

ARCAD (http://arcad.essi.fr) is acronym for *Architecture Répartie extensible pour Composants ADaptables*. It is a RNTL contract, started in 2001, for 3 years, involving 130 kEuros.

Members of this contract are: Rainbow (I3S CNRS UNSA), DTL/ASR (France Télécom R&D), Sardes (INRIA Rhône-Alpes) and OCM (École des Mines de Nantes).

Details of our contribution for this contract is developed in 6.2 and [32] .

7.2. GRID RMI : Programming the Grid with distributed Objects

GRID RMI (http://www.irisa.fr/Grid-RMI) is a software project of the French *Action Concertée Incitative* (ACI) *Globalisation des ressources informatiques et des données* (GRID) of the Ministry of Research. This project started in 2002, for 2 years, involving 38 kEuros.

The goal of this project is to promote a programming model for computing Grids. This model combines both parallel programming models and distributed programming models. It is based on the concept of distributed objects and software components for the distributed programming. This project targets to design and to experiment a high performance communication software framework enabling both efficient communication between objects or components and parallel programming.

Members of this project are: IRISA, LIP ENS-Lyon/LABRI Bordeaux, INRIA, I3S, LIFL, and EADS.

7.3. OSMOSE

OSMOSE (http://www.itea-osmose.org) is acronym for *Open Source Middleware for Open Systems in Europe*. It is a project, started in 2003, for 2 years, involving 60 kEuros.

The overall technical goal of the OSMOSE project is focused on the development, enhancement, and validation in defined test-beds of a comprehensive adaptable Open Source middleware to be hosted by the ObjectWeb consortium http://www.ObjectWeb.org.

The members of the project belong to 8 different European countries: Belgium, Czech Republic, France, Greece, Ireland, Netherlands, Spain and Switzerland. The project is built around three sets of partners: 6 large industrial companies (Bull, France Télécom, Philips, Telefonica, Telvent and Thales), 6 SMEs (Bantry Technologies, iTEL, Kelua, Lynx, VICORE and Whitestein Technologies), and 7 academic partners (CharlesUniversity, EPFL, INRIA, INT, LIFL, LSR and Universidad Politécnica of Madrid).

7.4. Data Grid Explorer

Data Grid Explorer is a project of the French *Action Concertée Incitative* (ACI) *Masse de données* of the Ministry of Research. This project started in 2003, for 3 years, involving 7 kEuros.

The project Data Grid Explorer aims at experimenting on large scale distributed systems on different features such as : fault tolerance, localization and performance.

Members of this project are: IMAG, LaRIA, LRI, LASSI, LORIA, LIP ENS Lyon, LIFL, LIP6, LABRI, IBCP, CEA and IRISA.

8. Other Grants and Activities

8.1. National Collaborations

8.1.1. ARC Modocop

Modocop (http://www-sop.inria.fr/lemme/modocop) is acronym for *Model checking Of Concurrent Object-oriented Programs*. This action started in 2002 for 2 years.

This project aims at automatic specification, verification and symbolic testing of concurrent object-oriented programs. It combines two important lines of research: verification of single-threaded JavaCard programs, which is mainly theorem-prover based; and application of symbolic techniques to generate tests for embedded applications, which can be analyzed using either finite model checking techniques or symbolic methods that can deal with infinite state systems.

Members of this project are: Lande (INRIA Rennes/IRISA), Lemme (INRIA Sophia-Antipolis), Oasis (INRIA Sophia-Antipolis), Vasy (INRIA Rhône-Alpes) Distributed and Complex Systems Research Group (Verimag), Vertecs (INRIA Rennes/IRISA).

This year we have contributed with our work on the specification of distributed Java applications, and on the tools for static analysis of those applications. This has been presented in the Modocop meetings in Sophia Antipolis (march), Rennes (june), Grenoble (december).

8.1.2. ARC Concert

Concert (*Compilateurs Certifiés* http://www-sop.inria.fr/lemme/concert) is an ARC (2003-2004) aiming at producing a realistic certified compiler, i.e. accompanied by a Coq equivalence proof between the source code and the generated code.

8.2. International Collaborations

8.2.1. Concurrency and Applications (Benchmarks) Group

Denis Caromel is co-leader of the *Concurency and Applications* working group of the *Java Grande Forum* (http://www.javagrande.org). The goal of the Java Grande Forum is to develop community consensus and recommendations for either changes to Java or establishment of standards (frameworks) for Grande libraries and services.

8.2.2. Proximos

Proximos (*Programmation Répartie Objet, réfleXIon, Meta-Objet et Sémantique*) is a bilateral collaboration between CONICYT and INRIA. We aim at gathering expertise on meta-object protocols, concurrency, transparent distributed programming, and verification of distributed systems. Contributions are related to reflection [28], garbage collection, and safe concurrency.

8.3. Visits, schools and conferences

- Visits:
  - Eric TANTER (PhD at University of Chile) (from 4 to 26 of January then from 4 to 15 of September).
  - Luis Mateu (University of Chile) was invited professor during April-July. He worked with us on the relationship between JShield and ProActive.
  - Visit of professor José Piquer (University of Chile) from 19 to 23 of May.
- Thematic schools:
  - Tomás Barros attended the school for young researchers: "Ecole Jeunes Chercheurs en Programmation" from May 26th to June 6th, Aussois, France. This school is organized each year and holds around forty participants, all of them, first year PhD (computer science) students.
  - Felipe Luna Del Aquila attended the school "ZISC Fall School on Formal Security Engineering", September 21st - 27th, Zurich.
- Conferences:
  - several members of the project took part in regular work meetings of projects MODOCOP, ARCAD, OSMOSE, GRID-RMI and ObjectWeb.

– Rabea Boulifa, Ludovic Henrio and Bernard Serpette took part in JFLA'2003 (January, Chamrousse) and presented the two articles [26] and [20].
– Alexandre Genoud took part in the ECOOP 2003 conference in Darmstadt, Germany. He presented a paper [21] in the workshop entitled *Exception Handling in Object Oriented Systems: towards Emerging Application Areas and New Programming Paradigms*
– Denis Caromel and Matthieu Morel took part in ObjectWeb meetings (January and September, Grenoble) and also, Françoise Baude during the 3rd annual ObjectWeb conference (November 20-21, Rocquencourt). Presentation of ProActive innovations: distributed and parallel components, mechanisms of deployment in a GRID infrastructure.
– Denis Caromel took part in DOA'03 (November, Catania, Sicily) and presented the article [17].
– Romain Quilici took part in Linux Solutions 2003 (February 4-6, Paris) Presentation of the ProActive Java library and demonstration of some applications with remote access on the cluster of Sophia Antipolis.
– Romain Quilici attended and gave an invited talk [25] on ProActive, and Components at the EURESCO Conference on *Advanced Environments and Tools for High Performance Computing*
– Arnaud Contes and Denis Caromel gave a talk *Declarative Security for GRID Applications: ProActive* during the InTech'Sophia session in June : *Sécurité sur Internet: est-ce possible ?*
– Participation of Eric Madelaine and Isabelle Attali at ETAPS'2003 (April, Warsaw).
– Presentation by Eric Madelaine at the workshop on model-checking for critical software systems, DNS'03 (June, San Francisco) [18].
– Participation of Denis Caromel (speaker [33]) and Tomas Barros at EJCP'2003 (may, Aussois).
– Several members of the project took an active part in the organization of IPDPS'03 (April, Nice).
– Tutorial of Denis Caromel on *Object-Oriented Middleware and Components for the Grid* at IPDPS 2003 [24] (April, Nice) and at Middleware 2003 [23] (June, Rio de Janeiro, Brazil).
– Communication of Denis Caromel during the Panel entitled *MPI Programming* during IPDPS 2003 [34]
– Denis Caromel co-organized a workshop on Distributed Java technologies [11].
– Several members of the project took part in RenPar'15 (October, La Colle sur Loup) and Laurent Baduel presented a paper at this conference [16].
– Presentation by Rabea Boulifa at the workshop Fidji'03 (November, Luxembourg).
– Demonstrations of ProActive on the INRIA booth, by Laurent Baduel and Denis Caromel at SuperComputing 2003 (November 15-21, Phoenix).
– Demonstration of Jem3D (the parallel object oriented application for electromagnetism, written using ProActive), during the last event of the 20th anniversary of INRIA Sophia-Antipolis http://www-sop.inria.fr/DR:I/20ans/20ans_cloture.html
– Denis Caromel has been invited at the Universidad Autonoma de Puebla, Puebla, Mexique. He gave two talks, *Programming Models for Future Systems vs. MPI* within the faculty seminar, and *Concurrent, Distributed, Parallel Objects and Components* as a specialized teaching for the students of Posgrado.
– Arnaud Contes took part in the SAR 2003 conference in Nancy, France. He presented a paper [15]
– Arnaud Contes took part in the ObjectWeb Security Seminar in Grenoble, France

9. Dissemination

9.1. Dissemination of scientific knowledge, responsabilities

- Isabelle Attali
  - was chair of LDTA2003 (Third Workshop on Language Descriptions, Tools and Applications), April, Warsaw.
  - was Industrial Track co-chair (with Kiran Bondalapati) for IPDPS (International Parallel and Distributed Processing Symposium), April, Nice.
  - was in the program committee of CC (Compiler Construction), April, Warsaw.
  - is in the steering committee of InTech'Sophia and has organized an InTech session in June : *Sécurité sur Internet: est-ce possible ?*, http://www-sop.inria.fr/intech/secure/index.htm.
  - was in charge of the panel "Ubiquitous Computing" for the closing of the 20th anniversary of INRIA Sophia Antipolis (Dec).
- Françoise Baude
  - was chair of RenPar'15 (Rencontres Francophones du Parallélisme) and chair of the organizing committee of the *Rencontres francophones en parallélisme, architecture, systemes* (see [10]).
  - is editorial chair for the special issue of the french journal TSI selecting the best papers having been presented during RenPar'15
  - was co-chair of the local organizer committee of IPDPS 2003
  - was in the program committee of LMO'2003 (Langages et Modèles à Objets)
  - is member of the program committee of the *Journées Composants 2004*
  - is member of the program committee of the PDCN 2004 *Parallel and Distributed Computing and Networks*
  - reviewed articles for JPDC, EuroPar 2003, CC-Grid 2003
- Denis Caromel
  - is member of the *Conseil scientifique de l'ACI Jeunes chercheurs*, Actions Concertées Incitatives du ministère de la Recherche et des Nouvelles Technologies
  - is member of the steering committee of ECOOP (AITO, Association Internationale pour les Technologies Objets)
  - is member of the steering committee of ACM SIGPLAN Java Grande ISCOPE Conference http://www.javagrande.org/
  - is member of the editorial board of the Journal of Object Technology, JOT http://www.jot.fm, published by ETH Zurich
  - is member of the editorial bord of *L'Objet*, (logiciel, base de données, réseaux) Hermes Science
  - is in the program committee of CCGrid'03, IEEE International Symposium on Cluster Computing and the Grid
  - is member of the program committee of HPDC-12, the IEEE International Symposium on High Performance Distributed Computing
  - is member of the program committee of *FMOODS'03*, the 6th IFIP International Conference on Formal Methods for Open Object-based Distributed Systems,
  - is member of the program committee of LMO'2004 (Langages et Modèles à Objets)
  - reviewed articles for PACT (IFIG WG 10.3, ACM SIGARCH, IEEE), International Journal Of High Performance Computing Applications (Sage Publications), EuroPar 2003

9.2. Teaching

- Françoise Baude
  - is member of the *commission de spécialistes 27ème section* at UNSA
  - is in charge of coordinating the Licence Informatique at UNSA
  - coordinates and is in charge of the courses on "Concepts of operating systems" in the Licence d'Informatique at UNSA and in the DESS Telecommunications at UNSA
  - gives courses on "Distributed systems" in the Maitrise MIAGE at UNSA
  - gives courses on XML technologies in the Licence MIAGE at UNSA
  - gives courses on Java programming in the Licence informatique at UNSA
  - gives courses on "Distributed Algorithms" in the DEA RSD at Unsa
  - gives courses on "Parallel Functional Programming" in the DEA RSD and DEA Informatique at UNSA
- Denis Caromel
  - coordinates the "Distributed Systems" track of the DEA RSD (Réseaux et Systèmes Distribués) at UNSA, in collaboration with CMA, CNET, Eurécom, INRIA Sophia Antipolis
  - is in charge of coordinating the DESS Télécommunications, within the département d'Informatique from UNSA
  - coordinates the course on "Concurrent, Parallel and Distributed Programming Languages" in the DEA RSD and DEA Informatique at UNSA
  - coordinates and is in charge of the courses on "Distributed Programming" in the Maitrise d'Informatique at UNSA
- Eric Madelaine
  - gives a course on "Méthodes formelles et fiabilité des systèmes informatiques" in the DEA Informatique at UNSA.
- Rabéa Boulifa
  - gives a course on "Calculabilité et complexité informatiques" in the Maitrise Informatique at UNSA.
- Laurent Baduel
  - has given one course on Computer Systems in DEUG Math-Info, second year
  - has given courses on programming languages in the License Informatique - UNSA
- Ludovic Henrio
  - has given one course on Security in Java Card in DESS Télécommunications, within the département d'Informatique from UNSA
  - gives courses on system programming at ESSI school - UNSA
- Arnaud Contes
  - gives a course on "Theory of languages" in the Licence Informatique at UNSA.
  - gives a course on "Introduction to the Gimp" in the DEUG Informatique at UNSA.
  - gives a course on "Introduction to UNIX" in the DEUG Informatique at UNSA.

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