Laboratoire Informatique de Grenoble

MOAIS

Multi-Programming and Scheduling Design for Applications of Interactive Simulation

Louvre, Musée de l'Homme
Sculpture (Tête)
Artist : Anonyme
Origin: Rapa Nui [Easter Island]
Date : between the XIst and the XVth century
Dimensions : 1,70 m high

http://moais.imag.fr

Laboratoire Informatique de Grenoble

CNRS — CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE

Institut National Polytechnique de Grenoble — INPG

INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET EN AUTOMATIQUE — INRIA

GRENOBLE 1 — UNIVERSITÉ JOSEPH FOURIER — SCIENCES, TECHNOLOGIE, MÉDÉCINE

MOAIS

1. **Présentation générale** [Jean-Louis Roch]

2. **Hardware&software platforms for interactive applications** [Bruno Raffin]

3. **Adaptive parallel and distributed applications with guaranteed performances** [Thierry Gautier]

Who are the Moais today ?

- **Permanent staff (7) :** INRIA (2) + INPG (3) + UJF (2)

  Vincent Danjean [MdC UJF]   Bruno Raffin [CR INRIA]
  Thierry Gautier [CR INRIA]   Jean-Louis Roch [MdC INPG]
  Guillaume Huard [MdC UJF]   Denis Trystram [Prof INPG]
  Grégory Mounié [MdC INPG]

- **Visiting professor (1) + PostDoc (1)**

  Axel Krings [CNRS/RAGTIME , Univ Idaho - 1/09/2004->31/08/05}
  Luciano Suares [PostDoc INRIA, 2006]

- **ITA : Adminstration (1.25) + Engineer (1)**

  Admin. : Barbara Amouroux [INRIA, 50%] Annie-Claude Vial-Dallais [INPG, 50%] Evelyne Feres[UJF, 50%]
  Engineer : Joelle Prévost [INPG, 50%] , IE [CNRS, 50%]

- **PhD students (14) :** 6 contracts + 2 joined (co-tutelle)

  Julien Bernard (BDI ST)   Jonathan Pecero-Sanchez(Egide Mexique)
  Florent Blanchot (Cifre ST)   Laurent Pigeon (Cifre IFP)
  Guillaume Dunoyer (DCN, MOAIS/POPART/E-MOTION)   Krzysztof Rzadca (U Warsaw, Poland)
  Lionel Eyraud (MESR)   Daouda Traore (Egide/Mali)
  Feryal-Kamila Moulai (Bull)   Sébastien Varrette (U Luxembourg)
  Samir Jafar (ATER)   Thomas Arcila (Cifre Bull)
  Clément Menier (MESR, MOAIS/MOVI)   Eric Saule (MESR)

+4   *Jérémie Allard (MESR, 12/2005)*   *Hamid-Reza Hamidi (Egide/Iran 10/2005)*
      Luiz-Angelo Estefanel (Egide/Brasil 11/2005)   *Jaroslaw Zola (U Czestochowa, Poland 12/2005)*

Objective

- **Programming on virtual networks** (clusters and lightweight grids)
  with *provable performances*

  - Applications where performance is multi-criteria and related to the number of resources

  - **Adaptability :**
    - **Static** to the platform : the environment evolutes gradually
    - **Dynamic** to the execution context : data and resources usage

- **Target applications : interactive and distributed simulations**

  - Virtual reality, compute intensive applications
    (process engineering, optimization, bio-computing)

computation

visualization

acquisition

Eg Grimage platform

MOAIS approach

- ## Algorithm + Scheduling + Programming
  - To couple local preemptive (system) and non-preemptive (application) scheduling to obtain global provable performances

    - *dataflow, distributed, recursive/multithreaded*

- ## Research thema
  - ### *Scheduling*
    - off-line, on-line, multi-criteria

  - ### *Adaptive* (poly-)*algorithms*
    - Various level of malleability : parallelism, precision, refresh rate, …

  - ### *Coupling* : efficient description of synchronizations
    - ⊳ **KAAPI** software : fine grain dynamic scheduling

  - ### *Interactivity*
    - ⊳ **FlowVR** software : coarse grain scheduling
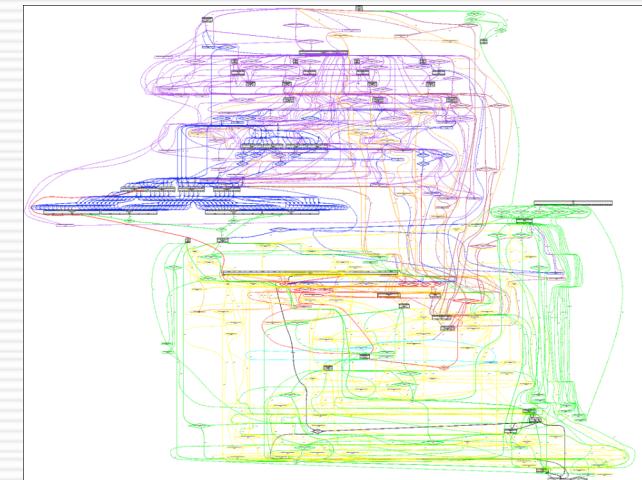
Scientific challenges

- **To schedule with provable performances for a multicriteria objective on complex architectures**

  eg - Time / Memory - Makespan / MinSum - Time / Work

  - Approximation, Game theory, …

- **To design distributed adaptive algorithms**

  - Efficiency/scalability : local decision but global performance
    - Dynamic local choices   - performance with good probability

- **To implement on emerging platforms**

  - Challenging applications (partners)

H.264 / MPEG-4 encoding on mpScNet [ST]
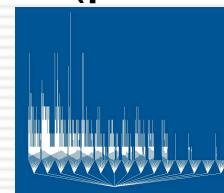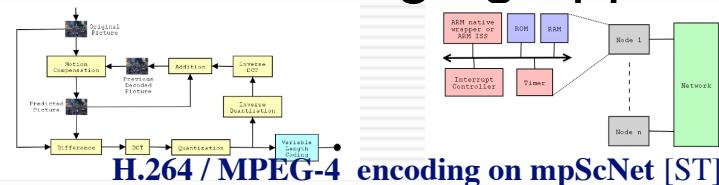
QAP/Nugent / CHOC
[PRISM, GILCO, LIFL]

Grimage (MOVI)

Perspectives

- **Scheduling and adaptive algorithms**
  - To meet algorithm adaptation and multicriteria objective
  - Goal : interactivity + continuity + coherency + precision

    Latency / refresh rate / synchronization / level of details
    - Workshop « Adaptive algorithms in scientific computing » SIAM-PP'2006 21-- 25/02/2006 San Francisco   http://meetings.siam.org/program.cfm?CONFCODE=PP06

- **Software : Kaapi+FlowVR**
  - coupling coarse-grain and fine grain scheduling

- **Fine grain / Embedded systems**
  - Transfer our SMP technology to multicore and MPSoC [ST]

- **Security on cyber infrastructures**
  - fault-tolerance, detection of intrusion   [Grid5000, ARA SafeScale]

MOAIS within the LIG

- **Moais'graal:** unified approach for adaptability with provable performances

- **Within the LIG : other concerns about adaptability :**
  - Targets application
    - resource management (**MESCAL**, SARDES)
    - virtual reality (**I3D**) (and also in LJK MOVI, ARTIS, EVASION)
    - realtime scheduling (**POPART**, **Emotion**),
    - Ambient interactive applications [PRIMA, IHM, MAGMA],
    - Virtial network security (Vasco)
  - To express and analyze adaptivity :
    - To express adaptivity [Fractal / SARDES]
    - Algorithmic complexity [CAPP]

- **LIG Platform : towards a multisite interactive platform**
  - MOAIS : « Grimage», clusters, SMPs, multicores

Questions ?

Jan. 2001 -> dec. 2005

- **Publications (110)**
  - ▶▶ 20 journal papers (18 int)   ▶▶ 58 reviewed conferences (51 int)

- **Main softwares**
  - ▶▶ **Kaapi**   ▶▶ **FlowVR** [Render]   ▶▶ OAR [Mescal / scheduling policies]

- **Platforms**
  - ▶▶ **Grimage**   ▶▶ Ciment, Grid 5000 [OAR, authentication]

- **Contracts (29)**
  - ▶▶ International : CoreGrid + 8 exchange agrrements
  - ▶▶ National [ANR] : 9 + 4 new
  - ▶▶ Industrial : 5 + 2 [*Microsoft, Pixelis*, ST, IFP, Bull] + [DCN] ST/MinaLogic Sceptre]

M O A I S

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