



Grid Programming for Distributed Remote Robot Control

Fabrice Sabatier, Supélec, Fabrice.Sabatier@metz.supelec.frAmelia De Vivo,Universita di Salerno, amedev@unisa.itStéphane Vialle,Supélec, Stephane.Vialle@supelec.fr





Action Concertée Incitative [ACI] Globalisation des Ressources Informatiques et des Données [GRID]





Why to connect an autonomous robot to a Grid ?

- To support special applications needing extra CPU
- To efficiently process embarrassingly parallel applications
- To dynamically switch to unloaded machines, avoiding to devot machines
- To be fault tolerant
- To share our robotic system with our (distant) partners









Robot & Grid testbed





Software Grid Architecture









RobGrid main features:

- C++ library, based on GridRPC
- Client objects for easy access to high level Grid services
- Manages redundant calls to high level Grid services
- Hides communication initializations with any service





Programming new high level Grid services:



Look at RobGrid library

Implement quickly a new one (calling RobGrid internal objects)

One high level Grid service = a set 4 of sub-services:

- Connection to the related service of the robot server
- Reset of the result buffers on the robot server
- Robotic operation (ex: navigation, localization, ...)
- **Disconnection** from the robot server



Performance measurement

Benchmark of localization routine on the Supelec sub-Grid:

• Frequently called (strongly optimized)





Performance measurement

Benchmark on 24h for localization operation across Internet:





Fault tolerance experiment

Running the complete application:

« Localization + navigation + lightness measurement »



- Application don't stop, and go on.
- Slow down is limited to the parts using a slower service.
- ? Fault tolerance is achieved.







Conclusion & Perspectives

- Design and deployment of a computing resource Grid for autonomous robot control:
 - [Internet VPN Corba DIET API-RobGrid Appli]
 - Supports concurrent and redundant calls
 - "Easy-to-use" high level library (RobGrid)

Experiment of autonomous robot control across internet:

- Overlapping comm., computations and mechanical moves
- Fault tolerance achievement (slow-down but go on)

Future:

- Extend the Grid
- Improve RobGrid API
- Control several robots across the Grid







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