Distributed object monitoring for ROOT analyses with Go4 v.3

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Go4 v3

The Go4 framework
New developments for v.3.0
Inter-task communication
Distributed Go4 monitoring
Go4 overview

Framework for many kinds of experiments
(Atomic & Nuclear Physics)

- The analysis is written by the user (unlimited ROOT)
- Services and interfaces for modular analysis setup
- **Batch mode** (CINT or compiled, on/off-line)
- **Interactive mode** (on/off-line):
  - A non blocking GUI controls and steers the analysis
  - Multithreaded communication layer between analysis and GUI task(s)
- Qt based GUI interfaces ROOT and Qt graphics (GSI Qt-ROOT)
- **User defined GUI** supported (Qt designer)
Go4 history and status

- Development start: April 1999
- Go4 v.1.0 May 2002
- Go4 v.2.0 November 2002
- Go4 v.2.9 April 2005 (stable?)
- Go4 v.3.0 (and “final” v2.10) November 2005
- Users:
  - At GSI: FRS, SHIP, AP, ESR, Rising, HypHI, HADES online, ...
  - Outside: TU Darmstadt, U Mainz, U Giessen, PTB, INFN, IN2P3, Leuven, Weizman institute, IMPCAS,...
Screenshot of Go4 v3
Go4 Analysis framework

- **TGo4Analysis base class:**
  - Analysis setup (modular: analysis steps)
  - Object organization
  - Event loop, run control
  - Open to wrap „foreign“ frameworks (ROOT/ C++/C)
    (virtual methods in user analysis subclass)

- **Event interface classes:**
  - event structure, event IO, processor
  - factories for analysis step initialization
  - implementations for ROOT TTree IO, GSI Mbs DAQ
Developments for v.3

- **Inter-task communication** redesign: multiple viewers at one analysis server
- **New Object manager** for GUI organization: decoupling of functionality and surface
- Redesign of **GUI elements**: browser, viewpanel, editors, new MBS monitor,...
- **ROOT session** (macro) may be controlled by Go4 GUI
- **ROOT session** (TBrowser) may control Go4 analysis
- Go4 distribution for **Windows XP** (without Qt!)
Go4 inter task communication

**Analysis process**
- **SERVER Task**
  - ANALYSIS loop
  - Object manager
- **CLIENT Task**
  - Go4 GUI
  - Object manager

**N Observer processes**
- **CLIENT Task**
  - Go4 GUI
  - Object manager

**Event IO:**
- DAQ
- Server
- Files
- User

**Auto save file**

**Commands**
- Objects

**TSocket (3x)**

**Connect request**
Developments for v.3

• **Inter-task communication** redesign:
  multiple viewers at one analysis server

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  decoupling of functionality and surface

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GUI object manager

- GUI OM
  - data sources
    - file.root
      - Analysis
      - histo1
      - histo2
      - histo3
    - Analysis
      - histo3
    - Parameter1
  - browser
    - file.root
  - widgets
    - Qt browser
    - view panel 1
    - parameter editor
  - TSocket connection

Supported data sources:
- TFolder
- TDirectory (TFile)
- TTree
- TCanvas
- Remote Go4 analysis
- GSI histogram server

- hierarchical structure of containers
- special proxies for different data sources
- single iterator for looping over complete structure
- message passing between different branches for notification purposes
- ROOT cleanup mechanism
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Go4 GUI remote features

connected as observer:

- **Object browser, view, property display** (histograms, conditions, parameters, event structure,..)
- **Object monitoring** (frequent refresh from analysis)
- **MBS DAQ status monitor** (from mbs node)

login as controller required!

- **Control and Go4 analysis setup**
- **Object editing** (window, polygon condition, parameter,..)
- **Dynamic histogramming** (on TTree or event structure)
- **ROOT macro execution** (in remote process)
## Go4 browser

### Browser Tree

<table>
<thead>
<tr>
<th>Name</th>
<th>Flags</th>
<th>Info</th>
<th>Date</th>
<th>Time</th>
<th>Class</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analysis</td>
<td></td>
<td></td>
<td>Controller</td>
<td>TGo4Analysis...</td>
<td>= 892068</td>
<td></td>
</tr>
<tr>
<td>Histograms</td>
<td></td>
<td></td>
<td>All Histogram objects</td>
<td>TGo4WindowCond</td>
<td>= 682080</td>
<td></td>
</tr>
<tr>
<td>Conditions</td>
<td></td>
<td></td>
<td>All Condition objects</td>
<td>TFolder</td>
<td>= 1456</td>
<td></td>
</tr>
<tr>
<td>Subfolder</td>
<td></td>
<td></td>
<td>UserFolder</td>
<td>TFolder</td>
<td>= 252</td>
<td></td>
</tr>
<tr>
<td>SpwWincon1</td>
<td>spw</td>
<td></td>
<td>Go4 window condition</td>
<td>TGo4WinCond</td>
<td>= 164</td>
<td></td>
</tr>
<tr>
<td>SpwWincon2</td>
<td>spw</td>
<td></td>
<td>Go4 window condition</td>
<td>TGo4WinCond</td>
<td>= 164</td>
<td></td>
</tr>
<tr>
<td>SpwPolycon</td>
<td>spw</td>
<td></td>
<td>Go4 polygon condition</td>
<td>TGo4PolyCond</td>
<td>= 120</td>
<td></td>
</tr>
<tr>
<td>SpwWinconar</td>
<td>spw</td>
<td></td>
<td>TGo4WinCond</td>
<td>TGo4WinCond</td>
<td>= 132</td>
<td></td>
</tr>
<tr>
<td>SpwPolyconar</td>
<td>spw</td>
<td></td>
<td>TGo4PolyCond</td>
<td>TGo4PolyCond</td>
<td>= 132</td>
<td></td>
</tr>
<tr>
<td>SpwChis1</td>
<td>spw</td>
<td></td>
<td>Go4 window condition</td>
<td>TGo4WinCond</td>
<td>= 164</td>
<td></td>
</tr>
<tr>
<td>SpwChis2</td>
<td>spw</td>
<td></td>
<td>Go4 window condition</td>
<td>TGo4WinCond</td>
<td>= 164</td>
<td></td>
</tr>
<tr>
<td>SpwConvxy</td>
<td>spw</td>
<td></td>
<td>1-0 window condition</td>
<td>TGo4WinCond</td>
<td>= 164</td>
<td></td>
</tr>
</tbody>
</table>

### Dynamic Lists

- **Parameters**: All Parameter objects TFolder = 2328
- **Pictures**: Picture objects TFolder = 134
- **CondSet**: Set conditions 2005-10-04 14:24:51 TGo4Picture = 82
- **Picture1**: Picture example TGo4Picture = 82
- **Canvases**: All TCansvases TFolder = 220
- **UserObjects**: For User Objects TFolder = 156
- **PHCalibration**: This is a test multiplot 2005-10-04 14:24:51 TGraph = 100
- **MultiHist**: This is a test multiograph 2005-10-04 14:24:51 TMultiGraph = 56
- **Aanalysistree**: This is a Go4 Status 0 TTree
- **XXXAnEvent**: TFolder
  - XXXAnEvent, TGo4Event...
  - XXXAnEvent, TGo4Event...
  - XXXAnEvent, TGo4Event...
  - XXXAnEvent, TGo4Event...
  - XXXAnEvent, TGo4Event...
  - XXXAnEvent, TGo4Event...
  - XXXAnEvent, TGo4Event...
  - XXXAnEvent, TGo4Event...
  - XXXAnEvent, TGo4Event...
  - XXXAnEvent, TGo4Event...
- **EventObjects**: Event objects of current event TFolder = 780
- **EventStores**: References to event stores TFolder = 52
- **EventSources**: References to event sources TFolder = 440
Go4 browser

monitor and filter tool

context menu
View panel

- Multi document interface
- TCanvas in QWidget
- Same histogram in different views
- ROOT editor
- Marker editor
Condition editor

2D polygon

1D limits

CHEP 2006 Go4 v3 - http://go4.gsi.de
Parameter editor

Remote editing of object (data structure) contents
Dynamic list editor

Histogramming “on the fly” from remote TTree, or event structure in memory
Mbs DAQ status monitor

Online event ratemeters, trending, remotely inspect status and setup
Developments for v.3

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Remote control of ROOT macro

Go4 GUI

ROOT

browser

run control

rate monitor

object monitor

hsimplego4.C
Remote control of ROOT macro

- Use **regular ROOT session**
- **Init script** to loads Go4 libraries and starts up analysis server task
  
  ```
  [root] .x go4Init.C
  ```

- **All methods of TGo4Analysis::Instance() available** in CINT via
  ```
  go4->...()
  ```

- **Register Root objects** in CINT / analysis script:
  ```
  go4RegisterAll() (all histograms in root memory), or
  go4->AddHistogram(TH1*), go4->AddObject(TNamed*),...
  ```

- **Optional run control methods** for macro:
  ```
  go4->WaitForStart() – suspend macro until start button pressed
  go4->Process() – break eventloop when stop button pressed
  ```
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ROOT session for Go4 control

Go4 menu

object monitor

Go4 folders

run control

Go4 analysis

ROOT

hsimplego4.C

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Go4 v3 - http://go4.gsi.de
ROOT for remote analysis control

- Use **regular ROOT session**
- Instantiate **TGo4Interface instance**
  ```
  [root] TGo4Interface::Instance()
  ```
- **Connect to running analysis**
  ```
  [root] go4->ConnectAnalysis("host.domain", 5000, 2);
  ```
- **Create TBrowser instance:**
  ```
  [root] new TBrowser
  ```
- **ROOT TBrowser** will contain “go4” folder, where all objects in analysis will be displayed
- **CINT API** (go4->...) for remote control
  ```
  LaunchAnalysis(...), ConnectAnalysis(...),
  SubmitAnalysisConfig(), StartAnalysis(), StopAnalysis(),
  ExecuteLine(...),...
  ```
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Distributed monitoring (1)
Distributed monitoring (2)

RFIO, XROOTd, PROOF?
Summary

Go4 well established as GSI “standard” software

Analysis framework

GUI (Qt and ROOT)

Inter-task monitoring and control mechanism

(Go4-Go4; Go4-ROOT, ROOT-Go4, ROOT-ROOT)

Linux; WindowsXP (non Qt); MacOS(?)

Go4 v3.0 available at http://go4.gsi.de