Quality Assurance for Simulation and Reconstruction Software in CBMROOT

Andrey Lebedev, Semen Lebedev, Florian Uhlig

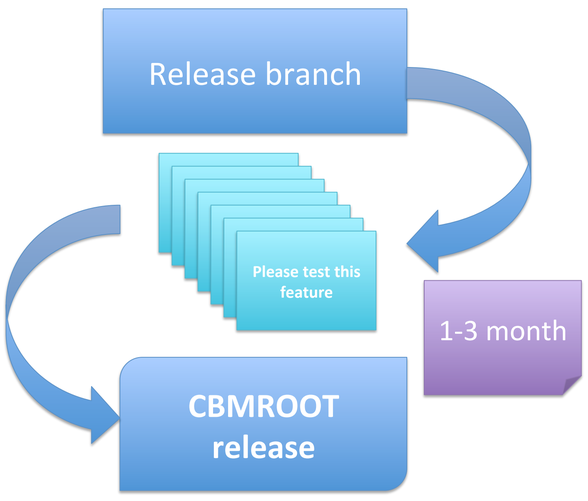
Institut für Kernphysik, Goethe-Universität Frankfurt, Germany; Justus-Liebig-Universität Gießen, Germany; GSI Helmholtzzentrum für Schwerionenforschung GmbH, Germany; Laboratory of Information Technologies Joint Institute for Nuclear Research, Russia

What is Quality Assurance (QA)?

"Set of systematic activities providing evidence of the ability of the software process to produce a software product that is fit to use"

G. Schulmeyer and J. McManus, *Software Quality Handbook*, Prentice Hall, 1998.

The problem aka how we did releases



Sometimes this process takes too much time ☹

① Simulation and reconstruction tests are done manually.
② Some features can only be tested by a particular user or developer.
③ Long development cycles, not reliable tests.

Main requirements

① Unified QA tool for event simulation and reconstruction.
② User friendly reports.
③ Automatic check of results based on predefined values.
④ Nightly monitoring of simulation results.
⑤ Modular design which is easy to extend.

Starting point CDash+CTest

Login All Dashboards — Wednesday, September 18 2013 09:44:38 CEST

CbmRoot

Dashboard Calendar Previous Current Project

No file changed as of **Wednesday, September 18 2013 - 00:00 CEST** — Show Filters Advanced View Auto-refresh Help

Nightly

Site	Build Name	Update	Configure		Build		Test			Build Time	Labels
		Files	Error	Warn	Error	Warn	Not Run	Fail	Pass		
lxir039.gsi.de	Squeeze-Sid64-linux-x86_64-gcc4.4.5-fairsoft_apr13	8	0	0	0	3	0	2 +2	24 -2	9 hours ago	(none)
cbm00.cbmnet	OpenSuSE-12.2-linux-x86_64-gcc4.7-fairsoft_apr13	0	0	0	0	500 +3 -1	0	0	26	9 hours ago	(none)
cbm00.cbmnet	OpenSuSE-12.2-linux-x86_64-gcc4.7-fairsoft_sep12	0	0	0	0	500 +4 -3	0	0	26	8 hours ago	(none)
PIKP156.UNI-MUENSTER.DE	OpenSuSE-12.3-linux-i686-gcc4.7-fairsoft_apr13	0	0	0	0	500	0	0	26	9 hours ago	(none)
fwklux5	squeeze-sid-linux-i686-gcc4.4.3-fairsoft_apr13	0	0	0	0	283	0	0	26	5 hours ago	(none)
lxi042.gsi.de	Lenny32-linux-i686-gcc4.3.2-fairsoft_jan12	0	0	0	0	279	0	0	26	6 hours ago	(none)
node18	SLC-5.9-linux-x86_64-gcc4.1.2-fairsoft_sep12	0	0	0	0	180 +3 -3	0	0	26	9 hours ago	(none)
lxplus440.cern.ch	SLC-5.9-linux-x86_64-gcc4.1.2-fairsoft_apr13	0	0	0	0	179 +1	0	0 -4	26 +4	8 hours ago	(none)
demac006	MacOSX10.6-darwin-i386-gcc4.2.1-fairsoft_sep12	9	0	0	0	12 -2	0	0	26	7 hours ago	(none)
node12	SLC-6.4-linux-x86_64-gcc4.4.7-fairsoft_apr13	0	0	0	0	8	0	0	26	7 hours ago	(none)
node12	SLC-6.4-linux-x86_64-gcc4.4.7-fairsoft_jan12	0	0	0	0	8	0	0	26	6 hours ago	(none)
node12	SLC-6.4-linux-x86_64-gcc4.4.7-fairsoft_sep12	0	0	0	0	8 +1 -1	0	0	26	7 hours ago	(none)
lxir010.gsi.de	Squeeze64-linux-x86_64-gcc4.4.5-fairsoft_apr13	0	0	0	0	8 -1	0	0	26	7 hours ago	(none)

① Very useful tool with nice web interface.
② Configuration, build and simple tests running on nightly and commit bases.
③ Test on different operating systems.
④ BUT NO check of simulation and reconstruction results.

Implementation details

QA Task (FairTask)
Creation of histograms
Calculation of performance

This is usual QA task which writes histograms to the output file.

This class draws histograms and writes the text output.

Representation of results to user
Reports: images, tables etc.

Histogram manager

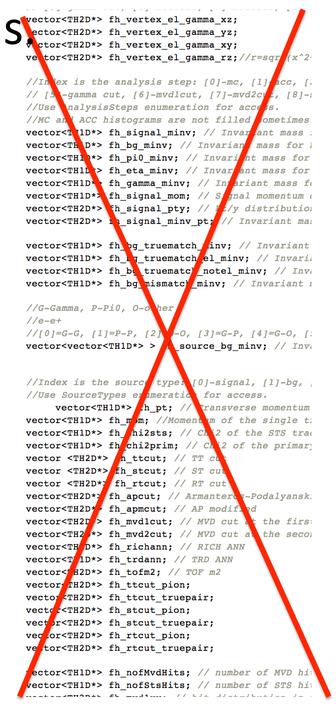
① Manage large number of histograms and graphs.
② Uniform access to histograms using **regular expression**.
③ Much less code, especially when histograms are created dynamically based on running conditions.

Decode information about histogram in its name:

```
htf_Sts_LastParam_Pull_Y
hte_StsTrd_StsTrdTof_Primary_Eff_p
```

Selection of histograms:

```
vector<TH1*> histos =
   fHM->H1Vector("hte_.+_Eff_.+");
vector<TH1*> histos =
   fHM->H1Vector("hth_.+_TrackHits_.+");
```



Reports

① Report generation routine uses ROOT file or histogram manager as input.
② Report is generated in different formats automatically.

Tracking efficiency

	Secondary	Reference	Proton	Primary	PionPlus	PionMinus	Ka
Trd (StsTrd)	86.2(45/52.2)	91.6(251.2/274.3)	91.8(77.2/84)	90.7(288.2/317.7)	89.8(103.1/114.8)	90.1(115.7/128.4)	94.
Tof (StsTrdTof)	85.9(33.6/39.1)	87.9(187.4/213.2)	87.7(58.3/66.5)	87.9(211.9/241.1)	88.8(76/85.7)	88.9(85.3/95.9)	89.
Sts (Sts)	71.1(101.9/143.4)	96(367.5/383)	91.3(111.2/121.7)	94.9(518.1/545.7)	92.7(201.1/217)	91.7(231.6/252.6)	95.
Sts (StsTrd)	85.5(52.2/61)	96.2(274.3/285.2)	95(84/88.5)	96.1(317.7/330.4)	95(114.8/120.8)	94.4(128.4/136)	95.
Sts (StsTrdTof)	85.9(44.9/52.2)	96(231.6/241.1)	95.3(72/75.5)	96(263.9/274.8)	94.8(94.6/99.8)	94.3(105.5/111.9)	94.
StsTrd (StsTrd)	73.7(45/61)	88.1(251.2/285.2)	87.2(77.2/88.5)	87.2(288.2/330.4)	85.3(103.1/120.8)	85.1(115.7/136)	89.
StsTrd (StsTrdTof)	74.8(39.1/52.2)	88.4(213.2/241.1)	88(66.5/75.5)	87.7(241.1/274.8)	85.9(85.7/99.8)	85.7(95.9/111.9)	89.
StsTrdTof (StsTrdTof)	64.2(33.6/52.2)	77.7(187.4/241.1)	77.2(58.3/75.5)	77.1(211.9/274.8)	76.2(76/99.8)	76.2(85.3/111.9)	80.

Tracking efficiency

	Pion	PionReference	Electron	ElectronReference	All	AllReference
Sts (StsRich)	95.2(10.4/10.9)	96.2(3.1/3.2)	99.1(12.7/12.8)	99.2(11.6/11.7)	93.5(32.8/35)	98.7(14.7/14.9)
Sts (StsRichTrd)	95.4(9/9.5)	96.4(2.7/2.8)	99(12.5/12.6)	99.2(11.5/11.6)	93.5(30.7/32.9)	98.8(14.1/14.3)
Sts (StsRichTrdTof)	95(8.1/8.6)	96(2.4/2.5)	99.1(11.8/11.9)	99.3(10.8/10.9)	93.4(28.4/30.4)	98.8(13.2/13.3)
StsRich (StsRich)	11.2(1.2/10.9)	33.8(1.1/3.2)	79.4(10.2/12.8)	85.7(10/11.7)	52.5(18.4/35)	74.8(11.1/14.9)
StsRich (StsRichTrd)	11.1(1.1/9.5)	33.7(0.93/2.8)	79.7(10.1/12.6)	85.8(9.9/11.6)	54.5(17.9/32.9)	76(10.9/14.3)
StsRich (StsRichTrdTof)	11.4(0.98/8.6)	34.1(0.86/2.5)	79.3(9.4/11.9)	85.6(9.3/10.9)	54.8(16.6/30.4)	76.2(10.2/13.3)
StsRichTrd (StsRichTrd)	10.9(1/9.5)	33(0.91/2.8)	71(9/12.6)	76.5(8.9/11.6)	47(15.4/32.9)	68.3(9.8/14.3)
StsRichTrd (StsRichTrdTof)	11.3(0.97/8.6)	33.7(0.85/2.5)	70.8(8.4/11.9)	76.5(8.3/10.9)	47.4(14.4/30.4)	68.7(9.2/13.3)
StsRichTrdTof (StsRichTrdTof)	10.4(0.89/8.6)	31.3(0.79/2.5)	51.2(6.1/11.9)	55.3(6/10.9)	34.9(10.6/30.4)	50.9(6.8/13.3)
Rich (Rich)	12.3(1.5/12.4)	35.2(1.2/3.5)	83.9(11.2/13.3)	90.6(10.9/12.1)	56.3(33.2/58.9)	78.4(12.1/15.4)

Pion suppression

	Pion suppression
Trd - WrongMatch	0 (304.3/0)
Trd - TrueMatch	0 (304.3/0)
Trd - All	0 (304.3/0)
TrdTof - WrongMatch	0 (304.3/0)
TrdTof - TrueMatch	0 (304.3/0)
TrdTof - All	0 (304.3/0)
Rich - WrongMatch	362.3 (304.3/0.84)
Rich - TrueMatch	1383.3 (304.3/0.22)
Rich - All	287.1 (304.3/1.1)
RichTrd - WrongMatch	0 (304.3/0)
RichTrd - TrueMatch	0 (304.3/0)
RichTrd - All	0 (304.3/0)

Reports can be used for one simulation or for studying different simulations. Interpretation of the results becomes much easier.

QA monitoring

① Automatic nightly test of simulation and reconstruction.
② Automatic check of simulation results.
③ About 20 tests run nightly.

Run simulation, reconstruction and QA as CDASH tests → Generate HTML report for each test and summary report → Copy resulting HTML reports to a web server

QA monitoring web server:
http://web-docs.gsi.de/~andrey/wwwqa/

*supported by BMBF and HIC for FAIR