Introduction in TBmon – A Testbeam Data Analysis Software

Reconstruction and Analysis Workshop

André Rummler

GEFÖRDERT VOM

Bundesministerium
für Bildung
und Forschung

Outline

- Output of reconstruction / Tbtrack file format
- Functionality
- Installation and basic configuration
- Available Documentation
- General Tbmon usage - workflow
- A quick look under the hood
- Outlook and Development

Output of reconstruction / tbtrack file format

- output created by EUTelAPIXTbTrackTuple processor of Eutelescope
- standard root file with trees and native data types
- 2d track points in local coordinates of the sensors
- hit information
- cluster information
- clustering is redone

Tree/Branch	Data type	Description
euhits		
nHits	int	Number of hits in this event
xPos	std::vector<double>	Global x coordinate [mm]
yPos	std::vector<double>	Global y coordinate [mm]
zPos	std::vector<double>	Global z coordinate [mm]
clusterId	std::vector<int>	ID of the corresponding cluster
sensorId	std::vector<int>	ID of the corresponding sensor
zspix		
nPixHits	int	Number of raw hits in this event
euEvt	int	Current event number
col	std::vector<int>	column of raw data hit
row	std::vector<int>	row of the raw data hit
tot	std::vector<int>	TOT of the raw data hit
lv1	std::vector<int>	LVL1 value of the raw data hit
iden	std::vector<int>	ID of the sensor
chip	std::vector<int>	ID of the sensor in the MCC board
clusterId	std::vector<int>	ID of corresponding cluster

eutracks

nTrackParams	int	Number of parameters for esti
euEvt	int	Event number
xPos	std::vector<double>	The fitted x position [mm]
yPos	std::vector<double>	The fitted y position [mm]
dxdz	std::vector<double>	The fitted derivate $\partial x/\partial z$
dydz	std::vector<double>	The fitted derivate $\partial y/\partial z$
trackNum	std::vector<int>	The track ID
iden	std::vector<int>	ID of the corresponding sensor
chi2	std::vector<double>	χ^2 of the track
ndof	std::vector<double>	tracks' degrees of freedom

euclusters

euEvt	int	Event number
size	std::vector<int>	Number of pixels in a cluster
sizeX	std::vector<int>	Cluster width in x [pixels]
sizeY	std::vector<int>	Cluster width in y [pixels]
posX	std::vector<int>	Position of the cluster in x [pixels]
posY	std::vector<int>	Position of the cluster in y [pixels]
charge	std::vector<int>	Sum charge of the cluster [TOT]
iden	std::vector<int>	ID of the corresponding sensor
ID	std::vector<int>	ID of the cluster

Functionality

- Read file and create objects
- Referencing
- Matching (for criterium see code): 1.5 * pitch
- Hotpixelfinder: out of time criterium
- Mostly modular, easy to add additional analysis:
- init, event, finalize

Installation and basic configuration

- Requirements:
    - CERN root – version does not really matter
    - C++ compiler, make system, doxygen if documentation
- Download it from CERN svn:
- svn co svn+ssh://svn.cern.ch/reps/atlasibltbsw/tbmon/ tbmon
- cd tbmon/trunk/ (usually trunk is used, read changelog!)
- cp siteconfig.h.example siteconfig.h
- Edit at least three lines in siteconfig.h:

    line 15: trySet(config.outPath, (char*) "/path/to/tbAnalysis/output");

    line 20: trySet(config.tbslot, (char*) "eudetfeb2011");

    and e.g. trySet(config.dataPath, (char*) "/path/to/tbAnalysis/data/

    cern_2011_sep_ibl/tbtrack");
- make

Available Documentation

- Unfortunately a bit lacking

- "doc" subdirectory: doxygen base, old "mainpage"

- Doxygen documentation effort ongoing

- New wiki, bug tracker, etc.:

  https://svnweb.cern.ch/trac/atlasibltbsw/wiki

- Some effort to document basic plots on private PPS twiki page:
  https://twiki.cern.ch/twiki/bin/view/Atlas/PhysicsAnalysis

  will be moved (hopefully) soon to the trac wiki

- "the code"

TBmon usage / workflow

- ./tbmon -help
- ./tbmon -s 61527 -a hotpixelfinder -c eudetIBLsep2011
- Typical order:
  - hotpixelfinder
  - checkalign
  - getetacorr
  - checkalign
  - all other analyses
- The first are analysis which produce output file which have to be set up in the driver.cc afterwards and tbmon needs to be re-build before the next step. Please take care of the location of the output files
- e.g. bool masknoisyanddeadpixels = false;
- Useful switches: -f, -v debug

A look under the hood

- Most important objects:
- Looper.cc
- TbConfig.cc
- Those two are calling each other several times
- Own event loop, not the root mechanism
- Certain limitations and inefficient code

Outlook / Current Developments

- Lots of work is currently done: refactoring → TbMon 2.0 (now 1.99)
- Current goals:
  - High eta analysis (remove cuts, different cluster center algorithms, extended input format, optimization routine etc.)
  - Improve output (everything into one root file) – in-build documentation:
  - Version of reconstruction software
  - Version of TbMon
  - All steering files
  - Input file names
  - Cuts, etc.
- Nicer plots
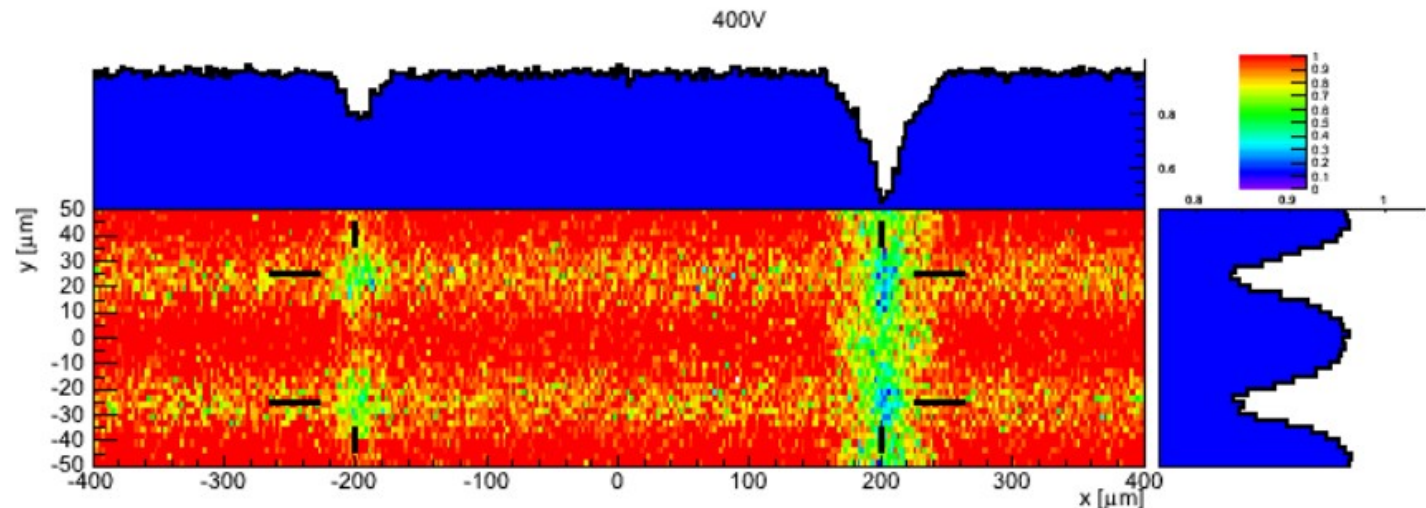
Outlook / Current Developments


```
currently executed macro name::/home/rummler/Softwa...

end time::Tue, 26 Mar 2013 09:58:57 +0000 (GMT) +33

processing uuid::1073741824

root version at compilation time::5.34/00

root version at run time::5.34/00

start time::Tue, 26 Mar 2013 09:58:47 +0000 (GMT)

tbmon dist version::1.9.9

tbmon svn version::exported
```
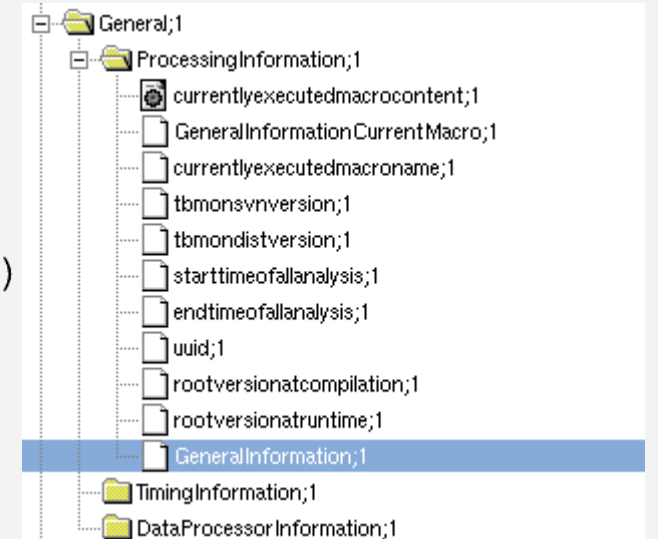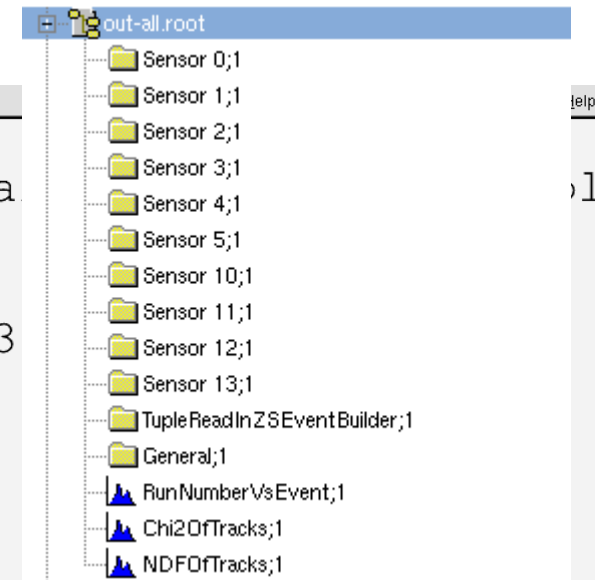
Outlook / Current Developments

- Lots of work is currently done: refactoring → TbMon 2.0 (now 1.99)
- Current goals:
    - High eta analysis (remove cuts, different cluster center algorithms, extended input format, optimization routine etc.)
    - Improve output (everything into one root file) – in-build documentation:
    - Version of reconstruction software
    - Version of TbMon
    - All steering files
    - Input file names
    - Cuts, etc.
- Move constants out of source into configuration files
- Better workflow (make the constant re-building superfluous)
- Better processing speed: optimization and probably parallel execution
- Automatized unit tests

# Extend tbtrack file format

- Timing information

timings

NTimings	int	Number of timings in this event
SensorId	int	ID of the corresponding sensor
TluId	std::vector<int>	TLU ID of this event
TpllId	std::vector<int>	TPLL ID of this event
RealtimeSec	std::vector<int>	Realtime since clock reset [s]
RealtimeNs	std::vector<int>	Realtime since clock reset [ns]
RunNumber	std::vector<int>	Number of the run

- General rotation information (next slide)
- Anything else? Make it general.

EUTelAPIXTbTrackTuple angle dumping feature

- For resolution studies a good knowledge of the entry point of particles/center of cluster for a hit is important
- Cluster sizes depend highly on angle of sensor for highly tilted sensors
- Efficiencies of cluster center finding algorithms depend highly on track angle
- Quite exact inclination angle is obtained from track fitting
- TbTrack processor has been extended to dump angles to output file
  - Now can be used by tbmon
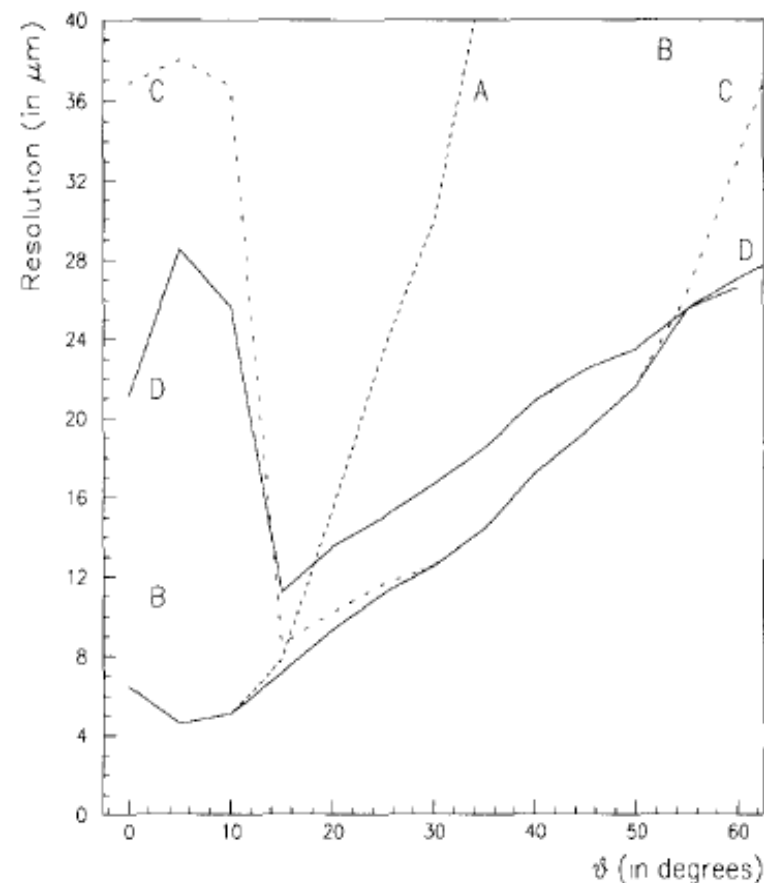
Resolution vs. angle for four cluster center finding algorithms

```cpp
void EUTelAPIXTbTrackTuple::getDUTRot(EUTelAlignmentConstant * alignment){
  int iden = alignment->getSensorID();

  for ( int layerIndex = 0 ; layerIndex < _siPlanesParameters->getSiPlanesNumber() ; ++layerIndex ) {
    int idencheck = _siPlanesLayerLayout->getID( layerIndex );

    if (idencheck == iden){
      //get rotations from gearfile
      double rotXY = _siPlanesLayerLayout->getLayerRotationXY(layerIndex);
      double rotZX = _siPlanesLayerLayout->getLayerRotationZX(layerIndex);
      double rotZY = _siPlanesLayerLayout->getLayerRotationZY(layerIndex);

      _rotDUTId->push_back(iden);

      //corrections from alignment
      _alpha->push_back(alignment->getAlpha());
      _beta->push_back(alignment->getBeta());
      _gamma->push_back(alignment->getGamma());

      //rotations from gearfile
      _rotXY->push_back(rotXY);
      _rotZX->push_back(rotZX);
      _rotZY->push_back(rotZY);

      //errors from alignment
      _rotXYerr->push_back(alignment->getAlphaError());
      _rotZXerr->push_back(alignment->getBetaError());
      _rotZYerr->push_back(alignment->getGammaError());
    }
  }
}
```
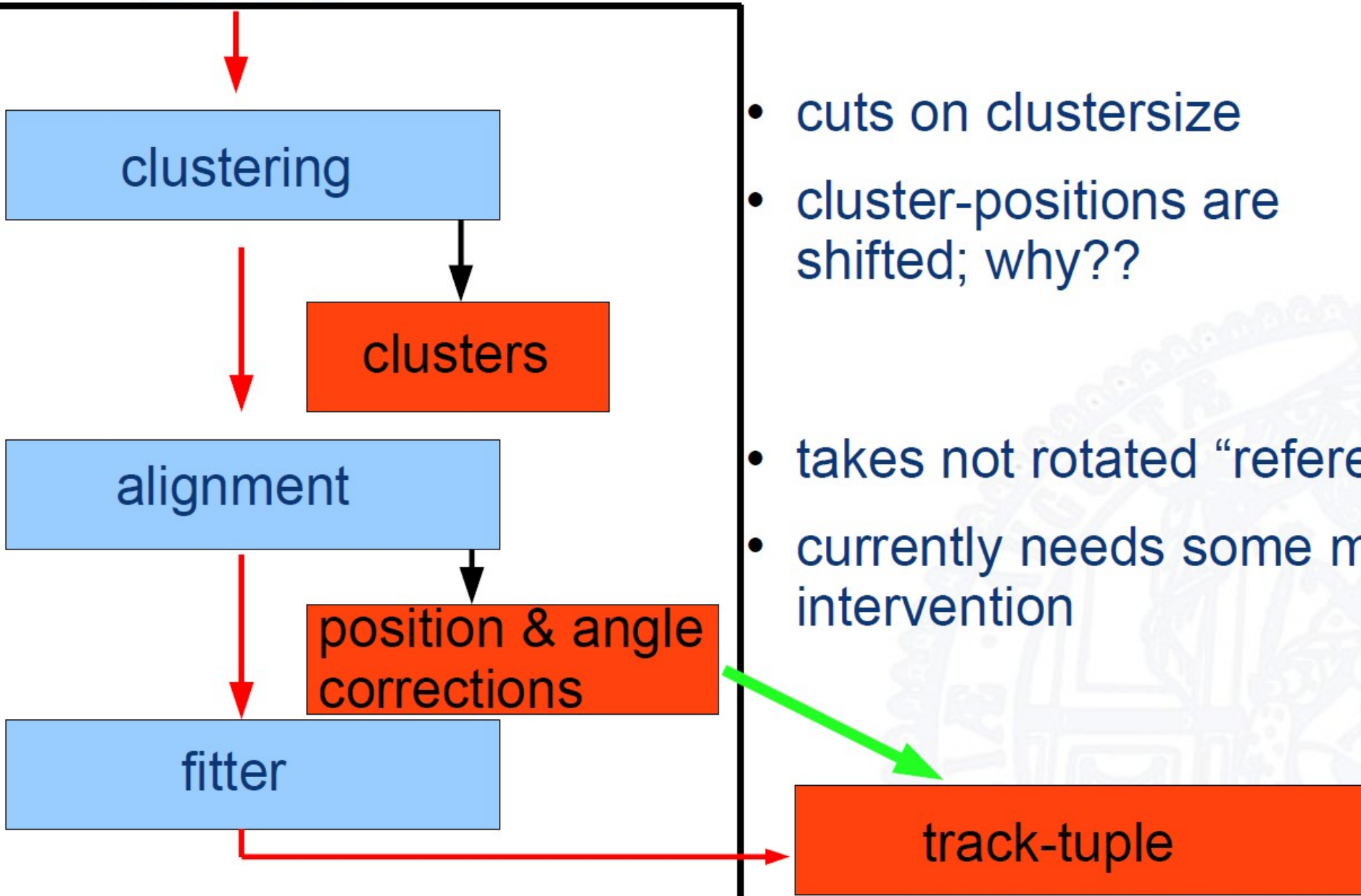
Backup

GEORG-AUGUST-UNIVERSITÄT
GÖTTINGEN

- cuts on clustersize
- cluster-positions are shifted; why??

- takes not rotated "reference"
- currently needs some manual intervention