New Track Event Model HowTo

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** How to get started*

- praticalities

- finding information

** Some guidelines*

• HowTo's

How to get started?

Practicalities

- Packages of new event model not yet part of official LHCb software releases
  - *Exceptions: LHCbID.h in Kernel/LHCbKernel, Event/TrackEvent*
- Working versions of all packages (done so far) for end of week
- Then all packages to go into next software release (thanks Marco)
- Plan to follow the official releases with updates, etc. …

How to get started?

Finding information

- Doxygen documentation of "at-present" classes and algorithms regularly updated at

  http://cern.ch/eduardo.rodrigues/lhcb/tracking/event_model

- CVS repository is where to check for latest versions
- Twiki pages of Track Event Model Task Force at

  https://uimon.cern.ch/twiki/bin/view/LHCb/LHCbTrackModelTaskForce

- Jose and myself are always happy to answer questions/doubts/…

Guidelines

Tracks

- Base class for tracks
- Other track classes may inherit from it, say internally in pattern recognition algorithms, if really needed
  - *Should be avoided as much as possible …*
  - *Additional features may be introduced in the base class, instead?*
- Main source of information (see later)
  - *No need – in most cases - to go through the states as in old event model*
  - *"first state" (the one always stored on DST) for getting p, pt, …, in many practical cases*

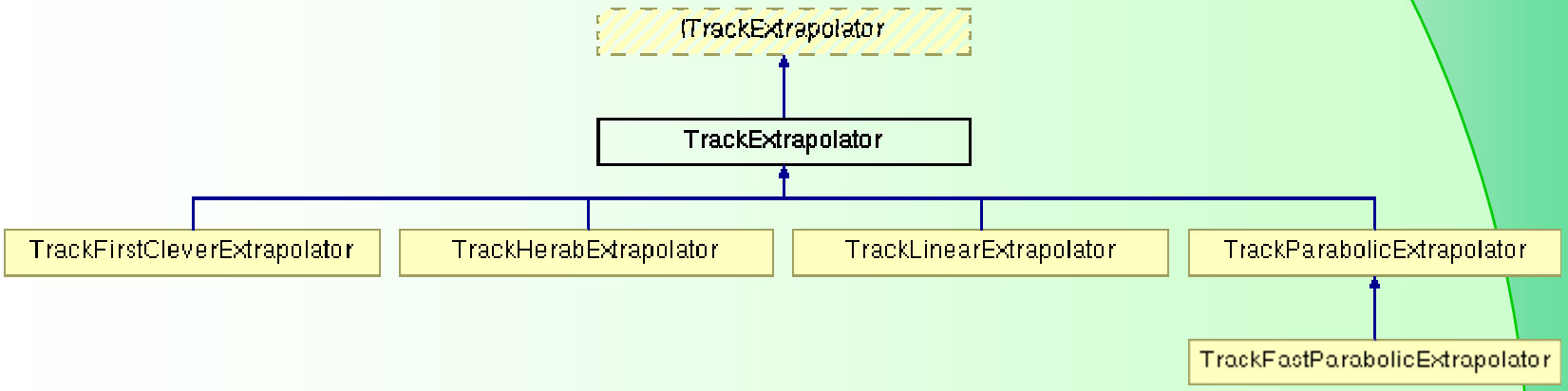
States

- Internal representation of the track, at different positions
- Not need in most cases
  - *The extrapolators do a lot of the job for you (see later)*

Guidelines

Extrapolators

- A variety of extrapolators, adapted and extended from the old model
- Useful for getting track info at a certain position (z, plane)
- User passes a track as an argument; it gets a state
  - *Makes available: position, momentum, covariance matrix, etc.*
- TrackMasterExtrapolator delegates the work
  - *Is still called TrackFirstCleverExtrapolator – to be changed*



Guidelines

Ideal pattern recognition package: Tr/TrackIdealPR

- Ideal pattern recognition adapted to work with new model
- Main algorithm for testing projectors, extrapolators, fitting, …
  - *First users got already their hands dirty with it: Jacopo, Edwin*
  - *You can be the next …*

Side remarks

- We made the choice of passing references as arguments to methods
  - *No need to take care about deletion of objects*
  - *E.g.: natural thing to do in tools (such as extrapolators) that do some job with a track but do not get ownership, etc.*
- "clone" methods return pointers
  - *Since the user is then naturally responsible for what it clones*
  - *User is responsible for deleting the objects cloned*

Getting general track info

```
// .cpp file

Tracks* tracksCont = get<Tracks>( "/Event/Rec/Track/Ideal" );

 debug() << "Tracks container contains " << tracksCont -> size()
         << " tracks" << endreq;

 Tracks::const_iterator iTrk;
 for ( iTrk = tracksCont->begin(); tracksCont->end() != iTrk; ++iTrk ) {
  Track& track = *(*iTrk);
  debug()
   << "-> Track  # " << track.key() << endreq
   << "  * charge              = " << track.charge() << endreq
   << "  * is of type          = " << track.type() << endreq
   << "  * is Backward         = " << track.checkFlag( TrackKeys::Backward ) << endreq
   << "  * # measurements = " << track.nMeasurements() << endreq;
  // …
  // position and momentum of the "first state" (i.e. the one stored on the DST)
  HepPoint3D pos;
  HepVector3D mom;
  HepSymMatrix cov6D;
  track.positionAndMomentum( pos, mom, cov );
// …
 }
```

```
// .h file
// from TrackEvent
#include "Event/Track.h"
#include "Event/TrackKeys.h"
```

Tracks flags, history, …

```
// .cpp file

…
Tracks::const_iterator iTrk;
for ( iTrk = tracksCont->begin(); tracksCont->end() != iTrk; ++iTrk ) {
  Track& track = *(*iTrk);
  debug()
    << "-> Track  # " << track.key() << endreq
    << "  * is Valid              = " << track.checkFlag( TrackKeys::Valid ) << endreq
    << "  * is Unique             = " << track.checkFlag( TrackKeys::Unique ) << endreq
    << "  * from algorithm        = " << track.history( ) << endreq
    << "  * Kalman fitted?        = " << track.checkHistoryFit( TrackKeys::Kalman ) << endreq
    << "  * has State at location BegRich1?    = " << track.hasStateAt( StateKeys::BegRich1 ) << endreq;
 …
 // get the state closest to, say, z = 2000.
double z = 2000.:
State& aState = track.closestState( z );
 …
}
```

```
// .h file
// from TrackEvent
#include "Event/TrackKeys.h"
#include "Event/StateKeys.h"
```

Extrapolating a track (I)

```
// .cpp file
// Retrieve TrackExtrapolator tool
 m_extrapolator = tool<ITrackExtrapolator>( « TrackHerabExtrapolator" );

 …
 Tracks::const_iterator iTrk;
 for ( iTrk = tracksCont->begin(); tracksCont->end() != iTrk; ++iTrk ) {
   …
   Track& track = *(*iTrk);
   double z = 3000.;
   State myState;
   // propagate the track to a z-position (getting all info via a State)
   StatusCode sc = m_extrapolator -> propagate( track, z, myState );
   if ( sc.isSuccess() ) {
     debug() << " -  state at position = " << myState.position() << endreq
             << "              momentum = " << myState.momentum() << endreq
             << "              transverse momentum Pt = " << myState.pt() << endreq;
// to access the position-and-momentum full covariance matrix
     HepSymMatrix& cov6D = myState.posMomCovariance();
   }
    …
 }
```

```
// .h file
// from TrackInterfaces
#include "TrackInterfaces/ITrackExtrapolator.h"

…
ITrackExtrapolator*   m_extrapolator;
```

Extrapolating a track (II)

```
// .cpp file
// Retrieve TrackExtrapolator tool
 m_extrapolator = tool<ITrackExtrapolator>( « TrackHerabExtrapolator" );

 …
 Tracks::const_iterator iTrk;
 for ( iTrk = tracksCont->begin(); tracksCont->end() != iTrk; ++iTrk ) {
   …
  Track& track = *(*iTrk);
  double z = 3000.;
  // propagate the track to a z-position (directly getting all info without passing via the State - PREFERRED)
  HepPoint3D pos;
  HepVector3D mom;
  HepSymMatrix cov6D;
  StatusCode sc = m_extrapolator -> positionAndMomentum( track, z, pos, mom, cov6D );
   if ( sc.isSuccess() ) {
     debug() << " -  track at z-position = " << z << endreq
             << "    has 3D-position = " << pos << endreq
             << "    momentum = " << mom << endreq;
}
    …
 }
```

```
// .h file
// from TrackInterfaces
#include "TrackInterfaces/ITrackExtrapolator.h"

…
ITrackExtrapolator*   m_extrapolator;
```