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Primary Vertex reconstruction

Introduction

There are 3 PV reconstruction algorithms

- PatPV2D - Used in HLT1, based on 2D VELO tracks
- PatPV3D - Used in HLT2, based on 3D VELO tracks
- PatPVOffline - used in Brunel, based on Best tracks

Redo full PV reconstruction (excluding some tracks) using IPVOfflineTool

- There is a possibility to redo PV search and fit in DaVinci excluding some tracks (possibly B decay products).

Initialization

in *your_algorithm.h*

```
#include "TrackInterfaces/IPVOfflineTool.h"
...
IPVOfflineTool* m_pvtool;
```

in *your_algorithm.cpp* initialize

```
m_pvtool = tool
```

Execution

Example how to redo single PV:

collect your tracks from signal B

```
std::vector<const LHCb::Track*> t2rem;
fill t2rem

LHCb::RecVertex redoPV;
sc = m_pvtool->reDoSinglePV(mypv.position(), t2rem, redoPV );
```

where mypv is the PV of the B origin. Checking StatusCode is important since procedure might fail (removal of some tracks). This method repeats the PV reconstruction procedure for a given seed excluding tracks from the t2rem vector. One can put any seed "const Gaudi::XYZPoint xyzseed" instead of mypv.position().

Example how to redo PV by rerunning full multi PV reconstruction:

collect your tracks from signal B

```
std::vector<const LHCb::Track*> t2rem;
fill t2rem

LHCb::RecVertex redoPV;
sc = m_pvtool->reDoMultiPV(mypv, t2rem, redoPV );
```

where mypv is the PV of the B origin. This method repeats the full multi PV reconstruction procedure and then matches one of the reconstructed PVs to input mypv. Matching is based on track comparison. It can fail so one has to check StatusCode.

Additional methods of IPVOfflineTool

There are two additional methods

- reconstructSinglePVFromTracks
- reconstructMultiPVFromTracks

They use tracks specified as argument instead of default tracks (Rec/Track/Best).

Reconstruction of displaced vertices (outside the beam spot xy envelope)

The standard reconstruction assumes that x,y of the PV is not far from the beam axis. The reconstruction efficiency drops down for $r >$ few milimeters. From PatPV version v3r4 on, there is a possibility to reconstruct all PVs including displaced ones. The example options are prepared in PatPV/v*/options/PVDisplaced.opts

- using PatPV3D algorithm and SpaceVelo tracks

```
ApplicationMgr.TopAlg += { "PatPV3D/PVDisplaced" };
PVDisplaced.PVOfflineTool.InputTracks = {"Rec/Track/Velo"};
PVDisplaced.PVOfflineTool.PVFitterName = "LSAdaptPV3DFitter";
PVDisplaced.PVOfflineTool.PVSeedingName = "PVSeed3DTool";
PVDisplaced.OutputVerticesName = "Rec/Vertices/myPVs";
```

- using PatPVOffline algorithm and Best tracks

```
ApplicationMgr.TopAlg += { "PatPVOffline/PVDisplacedOff" };
PVDisplacedOff.PVOfflineTool.PVSeedingName = "PVSeed3DTool";
PVDisplacedOff.OutputVertices = "Rec/Vertices/myPVsOff";
```

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Topic revision: r2 - 2008-07-31 - MariuszWitek



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