Visualisation of tracks using accurate model of ALICE detector magnets

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Introduction

- Reconstructed collision event data contains just the initial vertex and momentum of tracks
- ALICE Event Display uses ROOT::TEveTrackPropagator to re-propagate them
- Uniform constant magnetic field is assumed – only an approximation
- Detailed model of ALICE detector magnetic field from both magnets available, but not used for visualization so far
- Detailed model ported recently by our team to OpenGL for GPU rendering
- Now we ported the Propagator code to OpenGL and evaluated its performance
- We also tested how the detailed model influences tracking
- Full poster link:

Visual Inspection

- Tracks generated with constant field displayed here in red color
- Tracks generated with detailed field displayed here in blue color
- Slight differences in positions, curvatures and overall shape can be seen with a naked eye
Measurement of track deviation

<table>
<thead>
<tr>
<th>GPU</th>
<th>Algorithm</th>
<th>$\sqrt{\Delta x^2}$ [cm]</th>
<th>$\sqrt{\Delta y^2}$ [cm]</th>
<th>$\sqrt{\Delta z^2}$ [cm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Const</td>
<td>&lt; 0.01</td>
<td>&lt; 0.01</td>
<td>&lt; 0.01</td>
<td></td>
</tr>
<tr>
<td>1050 Ti</td>
<td>Const Barrel</td>
<td>&lt; 0.01</td>
<td>&lt; 0.01</td>
<td>&lt; 0.01</td>
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<tr>
<td>GLSL</td>
<td>3.956</td>
<td>4.136</td>
<td>6.569</td>
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<tr>
<td>2080 Ti</td>
<td>Const Barrel</td>
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- Our propagator with: constant field (\textit{Const}), constant field limited to ALICE barrel volume (\textit{Const Barrel}), the detailed model (\textit{GLSL}) versus \texttt{TEveTrackPropagator}
- No difference (down to floating point error) if constant field used - our implementation works correctly
- With the detailed model each track is displaced on average ~5 cm (vs const field)
• Propagator with constant field runs with 60 FPS in every tested case on both GPUs
• Propagator with detailed field runs with 60 FPS on the RTX 2080 in every case; on the older card performance drops to ~20 FPS when ~4000 particles are rendered
Summary

- Particle propagation successfully executed on the GPU using OpenGL and its geometry shader stage
- Generated tracks equal (down to rounding errors) to ROOT::TEveTrackPropagator when used with constant magnetic field
- With accurate magnetic field model visible difference in shape of tracks
- GPU propagator using constant field model achieves very good performance even on older GPUs
- The older, mobile GPU struggles with the accurate model, achieving barely real-time performance (20 FPS) when tested with average particle count of a Pb-Pb collision (ca. 4000 particles)
- This is a non-issue on the more powerful card, which ran the propagation with 60 FPS or more in every tested case