Towards A Unified Track-Finder Processor

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Generalize scheme to include $\eta$ dependence of matching and Pt-assignment in endcap and overlap regions
### Number of Extrapolation Units

**Per Sector Processor**

<table>
<thead>
<tr>
<th></th>
<th>DT</th>
<th>CSC</th>
<th>Overlap</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sector size</strong></td>
<td>30°</td>
<td>60°</td>
<td>60°(30°)</td>
</tr>
<tr>
<td><strong>Number of stations</strong></td>
<td>4</td>
<td>3 (4)</td>
<td>3 / 4</td>
</tr>
<tr>
<td><strong>Number of extrapolation pairs</strong></td>
<td>6</td>
<td>3 (6)</td>
<td>3 / 6</td>
</tr>
<tr>
<td>(1↔2, 1↔3, 2↔3, ...)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Source track segments / station</strong></td>
<td>2</td>
<td>3</td>
<td>2 / 3</td>
</tr>
<tr>
<td><strong>Target track segments / station</strong></td>
<td>12 (18)</td>
<td>3</td>
<td>3 ?</td>
</tr>
</tbody>
</table>

**Number of extrapolation units:**

- **DT:** 6 (or 9) neighbors in $\varphi$ and $\eta$  
  - No $\varphi$ sharing  
  - 144 (216)  
  - 48 (72)

- **CSC:** 3 (4) stations, no $\varphi$ sharing  
  - 27(54)

- **Overlap:** no $\varphi$ sharing  
  - 18-54+
## Inputs to a Single Pairwise Extrapolation Unit

<table>
<thead>
<tr>
<th></th>
<th>DT</th>
<th>CSC</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\varphi$</td>
<td>11 bits / 30°</td>
<td>12 bits / 60°</td>
</tr>
<tr>
<td>$d\varphi$</td>
<td>8 bits</td>
<td>6 bits</td>
</tr>
<tr>
<td>$\eta$</td>
<td>2 bits</td>
<td>11 bits</td>
</tr>
<tr>
<td>Quality</td>
<td>2 bits</td>
<td>3 bits</td>
</tr>
</tbody>
</table>
Block Diagram of Extrapolation Unit

Δφ calculation

η correlation

η, Δφ correlation

Quality correlation & assignment

Q₁ 3
Q₂ 3

Δφ₁₂ 6-8

Δφ₁

Δφ₂ 6-8

η₁ 11
η₂ 11

η 8?

&

φ

z
Φ Extrapolation (dφ, Δφ Correlation)

⇒ Checks consistency between Δφ and dφ
$\eta$ Extrapolation

$\eta_1$ <11 $\eta_2$ <11 $\eta$ LUT $\eta$

$\Rightarrow$ Need to determine necessary $\eta$ precision for remaining correlations
$\eta, \Delta \phi$ Correlation Unit

$\Delta \phi_{12} \sim 8 \quad \eta \sim 8 \quad \text{LUT} \sim 8 \quad <$

$\Rightarrow$ Limits $\Delta \phi$ as function of $\eta$

$\Rightarrow$ Not needed for barrel region, where $B$ is independent of $\eta$

$\Rightarrow$ Need to determine necessary $\eta$ precision
Quality Assignment and Correlation

\[ Q_1 \rightarrow \text{LUT} \rightarrow Q_{12} \]

\[ Q_2 \rightarrow \text{LUT} \rightarrow Q_{12} \]

⇒ Need to define criterion
Features and Limitations

- Trigger logic is tunable
  - Content of memory LUT is programmable
  - Any correlation unit can be set to accept all inputs
  - For example, turn off $\eta$ correlation for barrel region

- FPGA technology allows flexibility in logic design

- Design hopefully evolves into the same hardware for barrel, overlap, and endcap regions

- Neighboring $\phi$ sectors are not explicitly handled unless one copes with the additional number of extrapolation units and signal inputs

- Multiple hits in a single CSC chamber are not tested for ghosts (2 track segments $\rightarrow$ 4). Requires more extrapolation units
Further Study

- Minimize $\eta$ precision for $\Delta \phi$, $\eta$ correlation
  - Reduces LUT sizes
  - Simplifies $\eta$ determination for ME1/1 (tilted wires)

- Useful to have backward $\phi$ extrapolation ($2 \to 1$) ?

- Any problem from ghost hits in single chamber ?

- What is criterion for track quality assignment ?