

4D Pattern Recognition in VELO Upgrade-II

Shantam Taneja, John Cobble Dick

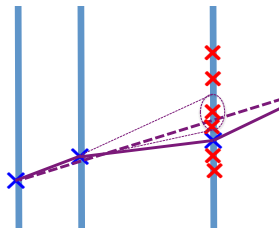
Mark Williams



16th July 2019

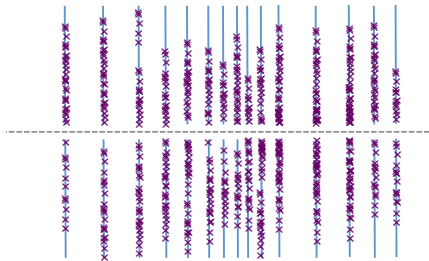
Various Problems

- Adding precise timing information to hits in VELO is a technological challenge and must be well motivated
- Can assist in vertex reconstruction, background rejection and PV association using per track timing
- **Interested in track reconstruction using 4D pattern recognition algorithms → provide per hit timing information**



Motivation

- Difficult to perform pattern recognition in the high luminosity environment of Upgrade-II (~ 42 PV's per bunch crossing)
- The Upgrade I detector configuration and track reconstruction aren't adequate (large combinatorics)
- Design a detector & reconstruction algorithm to achieve the required physics performance (i.e. efficiency, ghost rate and clone rate)



The RAMP framework

- RAMP kits provide the standard data samples (a list of hits and particles)
- Also a provision of scoring metrics (Efficiency, Ghost Rate and Clone Rate)
- The framework can host data as well as train and score an algorithm

- We host the data on CERNBox - many data samples simulating the different detector configurations

Detector Models:

- **Single Technology**
 - **55 μm** , no timing, 50 ps timing
 - **25 μm** , 75 ps timing
- **Dual Technology**
 - Inner:**25 μm** ,no timing, outer: **200 μm , 50 ps** timing
 - Inner:**25 μm , 100 ps** timing, outer: **200 μm , 50 ps** timing
- Can in principle have many detector configurations simulating the different pixel sizes and timing resolution

The *Alternative* RAMP Framework

- We host the data on CERNBox - many data samples simulating the different detector configurations
- The participants will train the algorithm on their own machines (allows for CPU/GPU flexibility)
 - Training data contains truth information → performance of algorithm determined by scoring metrics
- Apply algorithm to testing data and submit a list of tracks

- Ramp Kit can be found here:
<https://gitlab.cern.ch/shtaneja/ramp-velo-challenge->
- Contact us if you would like access to the repository

Thank You.
Good Luck with the Challenge.