Karlsruhe Institute of Technology

Institute for Information
Processing Technologies

CDCTRG 3DHough

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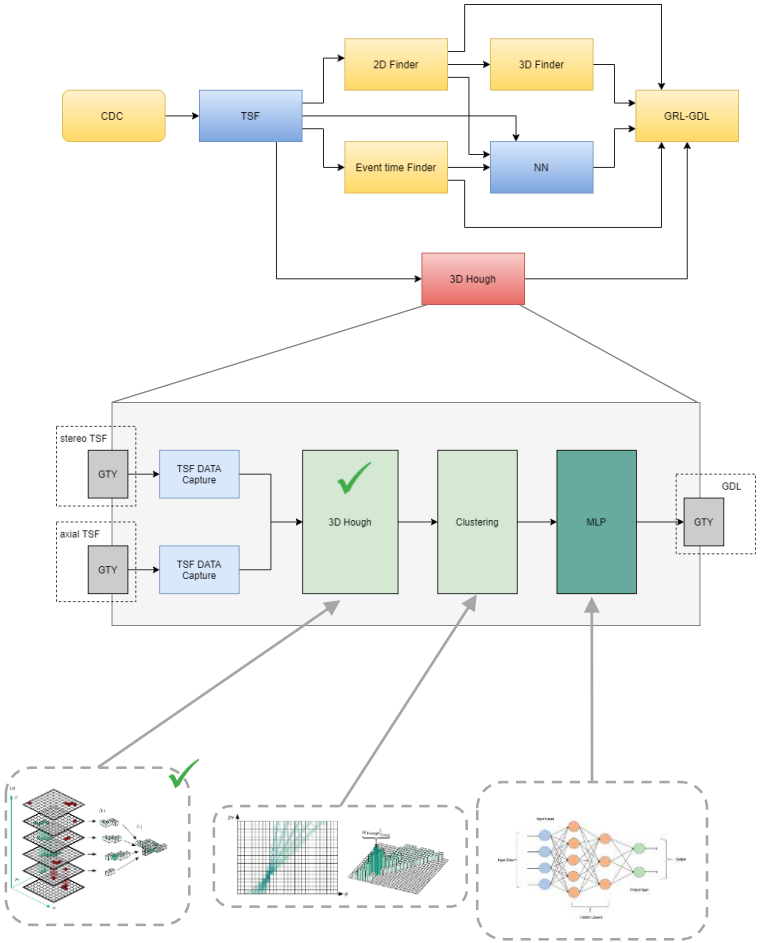
Outline

- 3D Hough
- Displaced Vertex Trigger (Hough)
- Displaced Vertex Trigger (GNN)
- ITIV Students

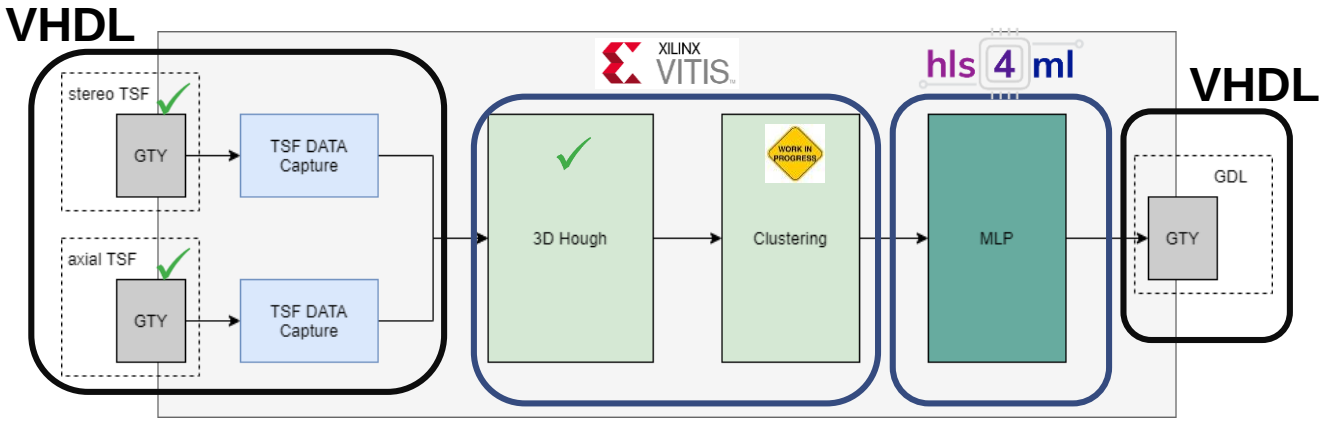
3D Hough z-vertex Track Trigger

- Better resolution in z and theta due to 3D Hough preorocessing
- Better fake track suppression
- More latency due to own preprocessing
- **Goal: an improved z-Vertex resolution and strong suppression of fake tracks**



3D Hough

- 3D Hough Transformation is done
- Working on the clustering part



3D Hough Clustering

	Unconstrained	Area-Constrained	Constrained
Area	Full Hough Map	7x7x7 Cubic	10x10x9 Cubic
Slices LUTs percentage	338 %	35 %	TBD
Latency in clock cycles	103 to 3961	6	14

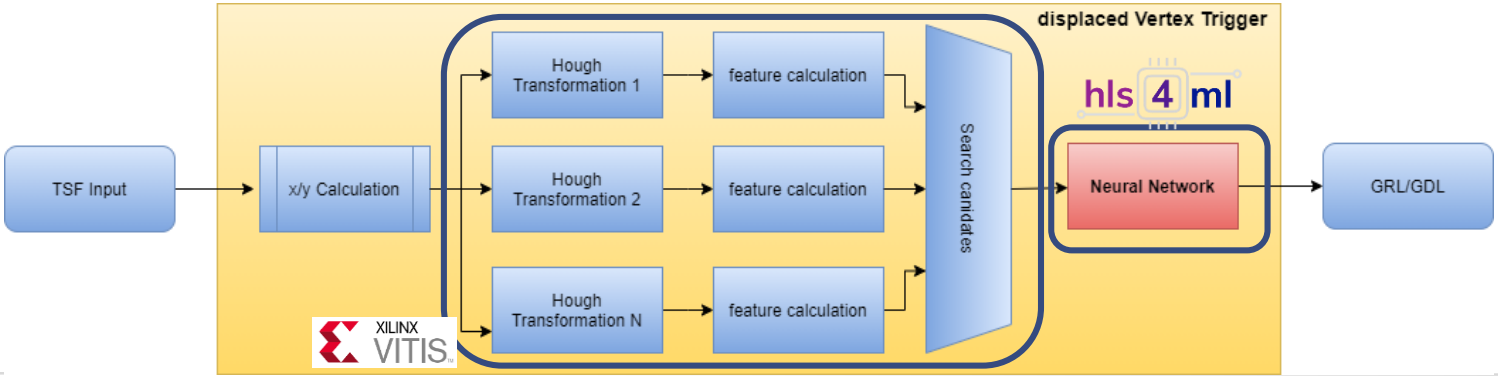
- Unconstrained clustering approaches doesn't fit requirements
- New Approached constrained by maximum cluster size
  - When the size gets too big it is a fake track

Problems & Plans

- Problems:
  - Sebastian leaving the field
  - Felix is finishing his PhD
  - Elia doing Displaced Vertex Trigger
  - **We have no one to train the network with 3D preprocessed variables**
- LAMA (Laboratory Applied Machine Learning Algorithms)
  - Recrute some students to train first networks
- Master Thesis for Network training

Displaced Vertex Finder (Hough)

- Uses parallel Hough transformations with hypothetical vertices distributed over the CDC transverse plane
- Calculate track feature using the shape of the Hough clusters
- Use neural network to estimate true track origin from Hough cluster variables
- Get the displacement from two-track vertex



Hough Transformation

- Need to fit ~400 Hough transformations in parallel

*	BRAM	DSP	LUT	Latency
Hough Transformation	2	21	15219	420

- Latency need to be reduced
  - Distance calculation needs to be modelled by physics
- The DSPs must be reduced
- Bachelor Student: Jinle Zhou
- Next Step: Master Thesis

*Preliminary Results

Displaced Vertex Trigger (GNN)

- More later from Lea Reuter (Torben Ferbers Group)
- Marc Neu joined ITIV as PhD student and will work on this from the hardware side

ITIV Students

- MA: Muning Xu
  - Machine Learning TSF
  - Its working, but much too big for FPGA at the moment
- BA: Ulrike Zweigart
  - CNN for Displaced Vertex Finding
  - Started in September