Summary of the EMU Software Workshop

22–24 February, UC Davis

Attendees: Acosta, Breedon, Case, Clare, Cox, Durkin, Hauser, Ko, Mani, Mumford, Tannenbaum, Wilkinson

Agenda

1. Simulation, digitization and reconstruction of hits

- The current status.
- Immediate mods after review of CMS note by Stan and Lisa.
- Attention to criticisms of existing simulation...
- Slightly longer term things... Fuller use of CommonDet.
- Things Rick and Tim haven't thought of...
- Various noise contributions to the simulation how best to model them?
- What for trigger digitization? How many strips should be digitized at once?
- What does the Trigger code need from the Digis that it doesn't already have?
- Is the current CMSIM simulation good enough? e.g. muon bremsstrahlung?

2. Geometry and Detector Description Database

- How to deal with mf.tz as a mix of geometry and detector parameters?
- How to deal with ORCA-related parameters which are not in mf.tz?
- What's wrong with the existing geometry (left-handed coordinates, no. wires and wire groups, constant delta-phi strip width) and how to fix?
- Why does Trigger code need to tune on geometry changes? How do we fix?
- How do we maintain geometry for GEANT*4*?
- Should we use XML? Examples.
- Should we use a real database? What that would be?

Agenda (Cont'd)

3. Trigger primitives [Tannenbaum] and trigger

4. Noise and neutron background

5. Calibrations

6. Tracking and physics objects

7. Endcap in the PRS/mu organization

CMS Notes Reviewed

"Simulating the Muon Endcap in ORCA"

- Authors: T.Cox, R.Wilkinson
- Referees: L.S.Durkin, L.Gorn

"Endcap Muon Trigger Primitive Software"

- Author: B.Tannenbaum
- Referree: D.Acosta

CSC Digi Simulation Issues

Cathode simulation still too idealistic

- Not all sources of noise included, nor gain variations: electronics 2% chip-chip, 1% channel-channel; 20% chamber
- Variations in cross-talk needed
- Information from OSU and UF will be incorporated on amplifier and chamber response

Comparators used by CLCT Trigger are too naïve in current simulation

- No pedestal fluctuations, no saturation of 4X amplifier
- Parameters will be determined by UCLA
- Resolution in ϕ will be degraded for L1 Trigger

No realistic anode simulation

- Amplifier and discriminator response not simulated
- No noise, no gain variations, no threshold variations
- Input required from CMU
- BX identification efficiency in L1 will be slightly reduced (100% ® 99%)

CSC Digi Simulation (Cont'd)

CSC digis will be tagged whether an LCT triggered the DAQ readout

- ➔ DAQ bandwidth is reduced by limiting digitization only to regions with a trigger primitive
- ➔ Simulation data won't be thrown away, just tagged

Action Item: Need input from ME1/1 community on noise/amplifier response of their chamber

CSC Trigger Simulation

Linking of CSC Trigger to geometry needs to be handled generally, rather than hardcoded

- ORCA_440 was broken for a while w.r.t. ORCA_432

Software algorithms need to be updated to match LCT hardware being developed this year

- Remove card boundaries and add more patterns
- Should improve η resolution used by Track-Finder

Mumford will continue development of CSC trigger primitive software

CSC Track-Finder algorithms being improved to study next-generation prototype

- Front/Rear chamber Z information improves P_T resolution from 24% to 20%.

Neutron Background Simulation

Biggest factor affecting CSC performance

- High rate of large amplitude pulses seen in GIF data
- Can overlap and distort CSC pulses from muons
  - spatially and temporally
- LCT trigger logic builds in 4-fold coincidence to reduce background rate

Current simulation:

- UCDavis parameterization based on CMSIM 112 creates GEANT hits (JUNK flag), which in turn are fed to ORCA
- Need to determine if large amplitude pulses (rather than MIPs) are seen in ORCA simulation
- All neutron hits appear at center of chamber rather than spread uniformly (under investigation)
- Current rHit simulation (and thus HLT Track-Finding) may break down because of large combinatorics when neutron hits are added
  - All possible x-y combinations of clusters are formed
  - Distortion in starting-time of DAQ readout
  - May need an LCT-like coincidence to suppress background

Suggested Remedys

Determine whether current JUNK simulation could be made more realistic, and update with new geometry and material

- ➔ UCDavis will investigate current software, and will process new minbias datasets

Create a new mechanism to incorporate neutron hits into ORCA using data

- ➔ Parameterize (or overlay) real CSC data from GIF onto CSC digis, match to calculations of neutron fluency in CMS
- ➔ Requires conversion calculation from neutron fluency (e.g. Huhtinen) to gamma-induced CSC hit
- ➔ Probably best way to emulate what the real chambers see (handles all spatial and temporal correlations)
- ➔ Consistent with software path CMSIM ® OSCAR
- ➔ R.Wilkinson will investigate, but will require more manpower (UCR?)

Detector Parameters, XML, DBs

XML was proposed as a new way to set CSC detector parameters in ORCA

- Currently, mf.tz used by CMSIM stores both geometry and detector parameters such as wire group count
- A new method is needed for when CMSIM is abandoned. There are too many parameters to set .orcarc values for these, and anyway one needs to store files in a common area
- M.Case (EMU sw eng.) is implementing tools to convert TZ files to XML as well as XML to TZ
- First project will be to incorporate needed changes to wire and strip parameters into XML

A general discussion ensued about how to store all geometry constants, including misalignments of certain chambers

- Clearly a DB will be needed by the time data is taken to store all chamber offsets. Also, it would be advantageous if both the simulation (Geant4) and reconstruction referred to the same DB
- For the short term, we may implement a method to adjust the position of any CSC chamber in ORCA for misalignment studies

Conclusion

This was a very useful workshop, bringing together software developers and CSC electronics experts

- ➔ Closes the loop on validating CSC ORCA simulation

Much of the CSC simulation is right!

- ➔ Very good first approximation to CSC system

Detailed CMS Notes are nearly complete

Still much work to do, however, to make the current simulation even more realistic

Biggest action item is to improve the neutron background simulation

- ➔ Big job. Requires manpower that is not yet identified

The US Endcap Muon software community is growing with the addition of students, postdocs, and faculty (UCLA, UCR, UF)

EMU representative proposed for Muon PRS (Acosta)