High Speed Continuous DAQ System for Readout of the ALICE SAMPA ASIC

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For the ALICE collaboration

ALICE Experiment and Upgrade
- ALICE experiment under the influence of heavy ions (Pb-Pb, p-Pb) at collisions at 2.76 TeV, to characterize the strongly interacting matter at extreme energy-density, where Quark-Gluon Plasma (QGP) is produced.
- ALICE has successfully completed Run1 (2010-2013).
- Run2 is in progress (2015-2018).
- The ALICE TPC upgrade project (DIP, ITH, BPTC) will be completed in 2020.
- The ALICE TPC Tracker Chamber will be upgraded to GEM readout technology and a parametrised readout system is being accommodated for the higher collision rates (200-400 Hz) during Run2.

High-Speed Data Acquisition System

- SAMPA Test Framework - DAQ System
  - Firmware design for system-on-chip board
  - SAMPA Controller
    - Control program for the SAMPA cards
  - SAMPA Programmer
    - Data acquisition and on-line monitoring using ROOT framework.

- SAMPA Detector - DAQ System
  - Data acquisition for the calorimeter and muon system.
  - Data transfer to the SAMPA cards.
  - SAMPA Cards
    - Data acquisition and on-line monitoring using ROOT framework.

- SAMPA Communication
  - Software environment to control and configure the DAQ and the SAMPA cards.
  - User-friendly interface for remote control.
  - Simplified configuration:
    - Clock configuration on the fly.
    - Data flow handling.
    - Online auto information.

- SAMPA Analyser
  - Signal data acquisition with the SAMPA board.
  - Monitor data:
    - Raw data:
      - Data transfer and data processing.
      - Data flow handling.
    - Offline data:
      - Store data in ROOT file.
      - Store data in ROOT file, offline analysis using ROOT data.
  - Monitor and analysis of multiple channels in parallel.

Test Setup and Analysis
- Performance tests of the complete SAMPA system were carried out with charge-generating data.
- Signal generator.
- GEM detector chamber.
- Event reconstruction (amplitude, time) of the SAMPA output signals was done by applying following methods:
  - Peak search.
  - Integrating samplers in the signal region.
  - Raising error following function
  \[ y = A \left( 1 - e^{-x/B} \right) \]

Where, \( A \) is a peak, \( x \) is the shaping order of the amplifier, the waveform amplitude is defined by \( B \). The resolution is \( A \) in the timing, and \( 1/e \) in time of the waveform.

Results
- Gain linearity.
- Charge-shape stability.
- F pedestal.
- Timing linearity.

E = 5 GeV (5.5 MeV) energy spectrum - Signal gives better result
- SAMPA trigger gain 0.25 MeV/NC.