RESEARCH ON NEUTRON INSTRUMENT STREAMING DATA PROCESSING AT CSNS

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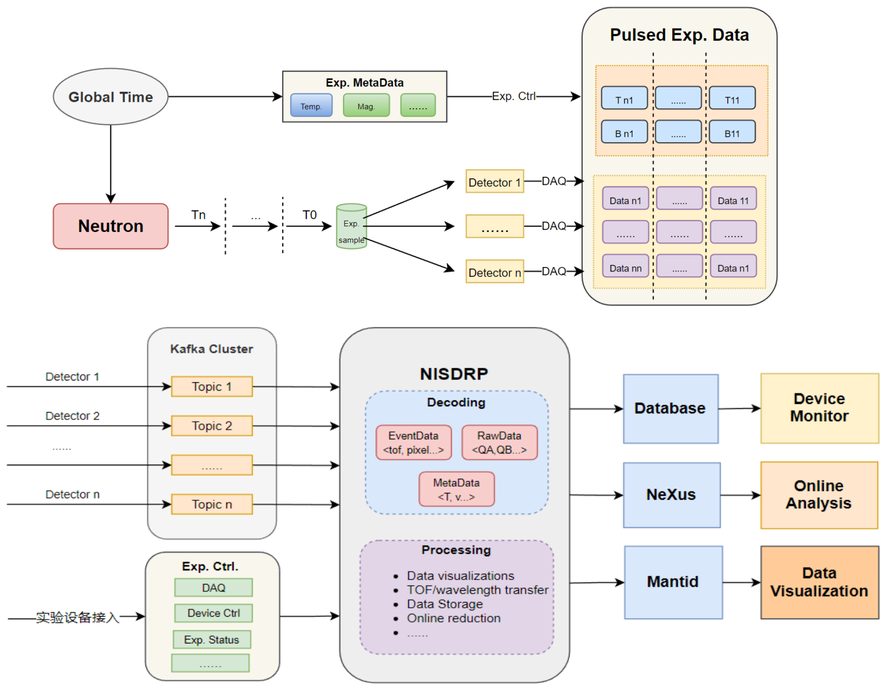
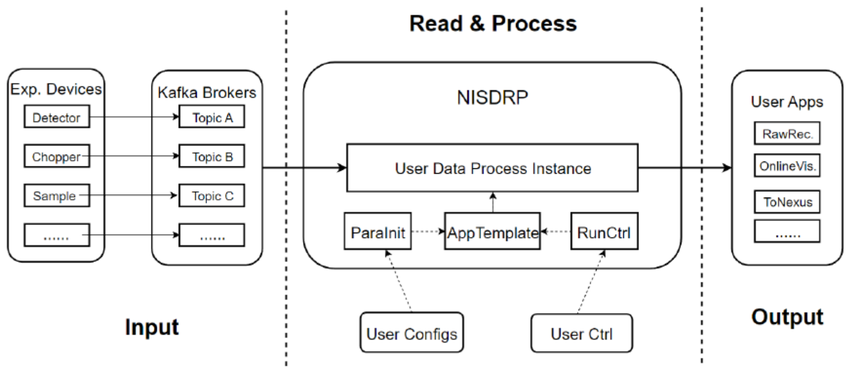
Introduction

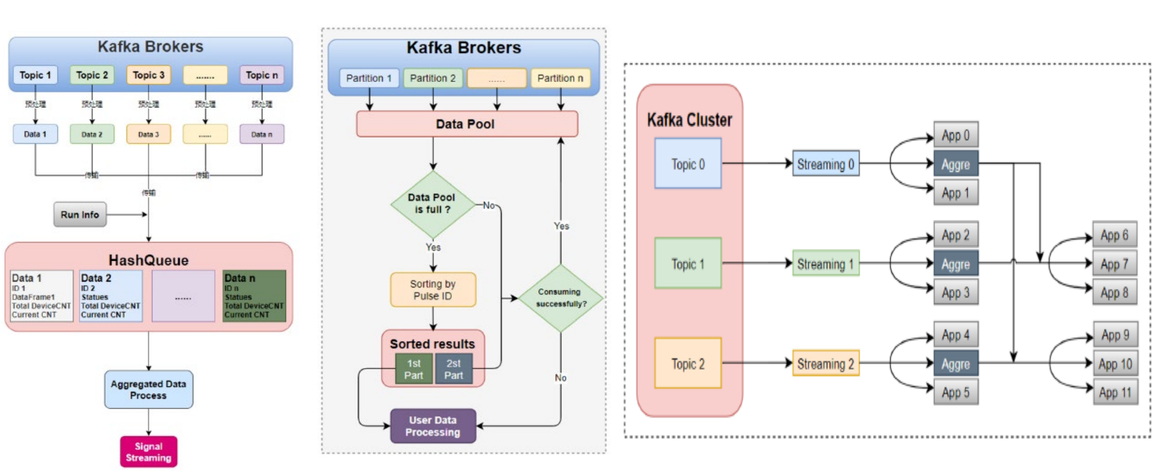
- The development of streaming data acquisition, transmission, and processing is the future direction for next-generation high-throughput, high-performance neutron instruments. At CSNS, a new generation of neutron instrument data streaming systems has been developed based on a distributed streaming data software platform. After validation and testing, it has been successfully applied in engineering on newly constructed neutron instruments.
- By designing and implementing a generalized streaming data processing platform, the distributed streaming data system can be adapted to various data processing needs of neutron instruments. This approach enhances user data efficiency and facilitates the transition from traditional offline data processing to real-time data analysis.

Framework Design



Encapsulate various data stream readout and processing methods at the lower level and abstract diverse back-end data processing applications.

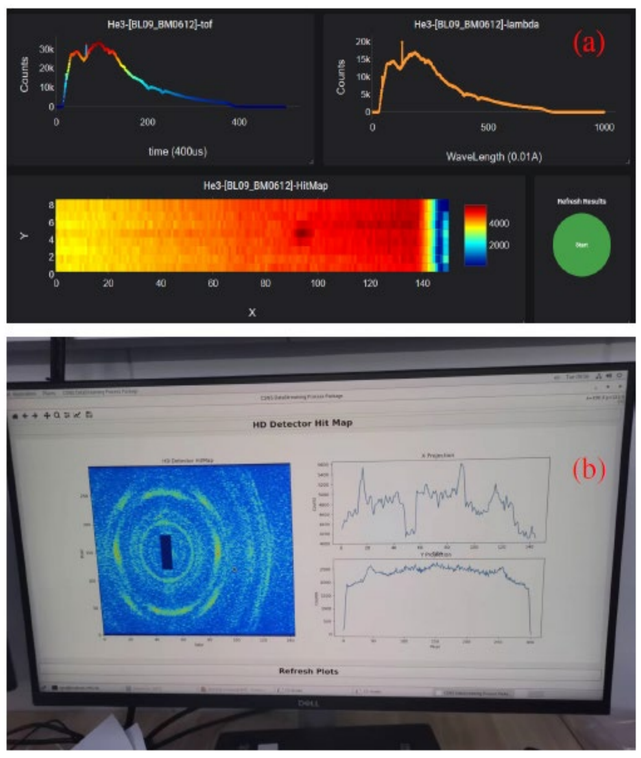




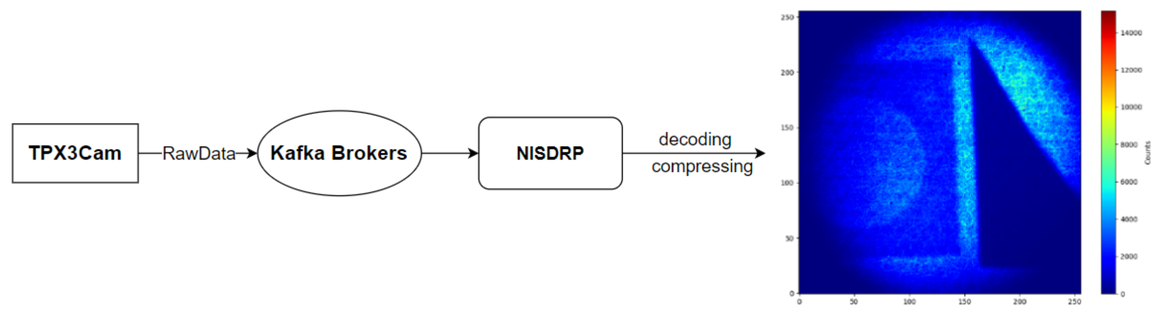
The lower layer is designed and implemented with various neutron instrument data processing algorithms, while the upper layer provides application modules for data visualization, offline storage, monitoring and alerts, and aggregation analysis.

Data Visualization

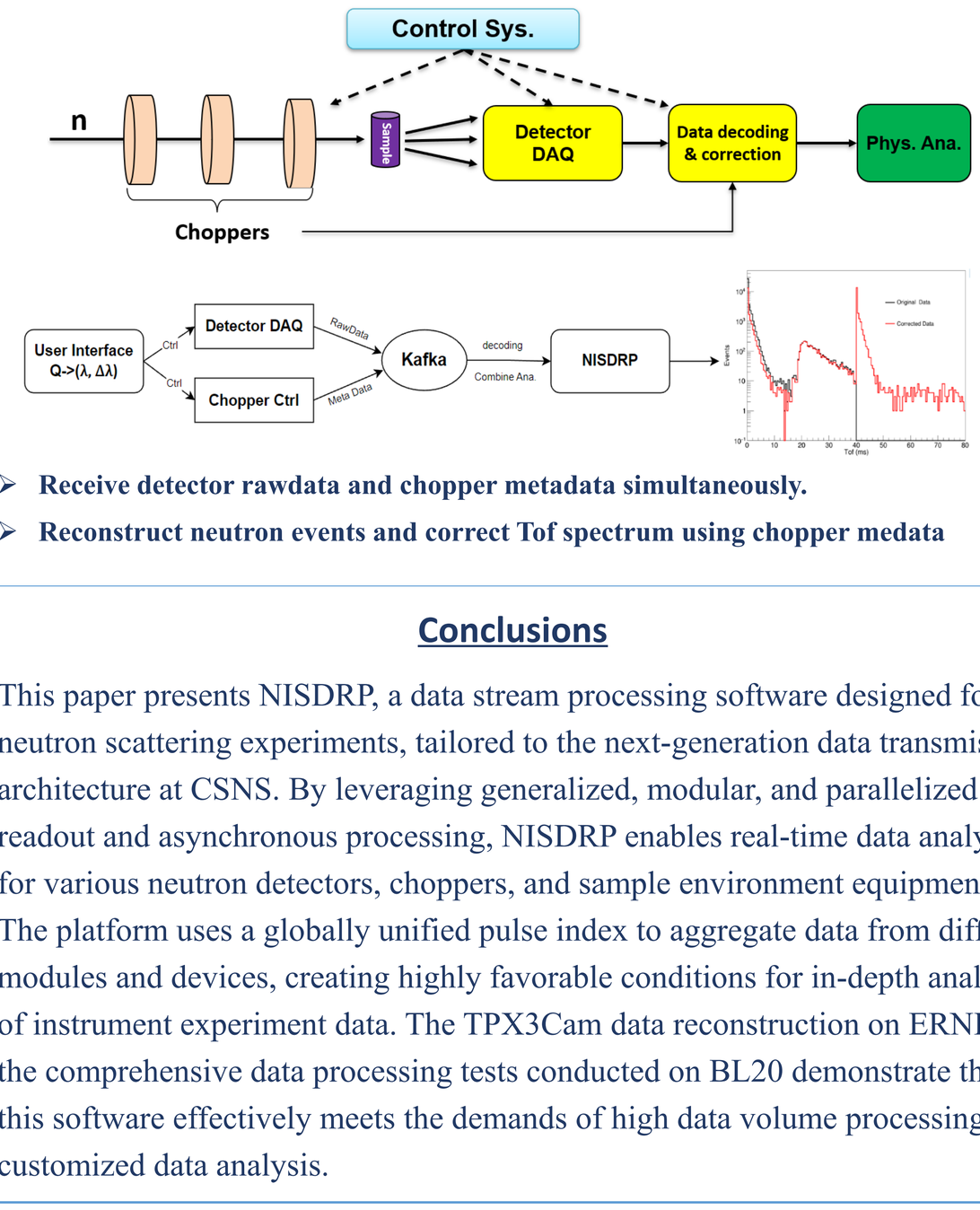
- Web-based: connecting with InfluxDB and Grafana, users can conveniently access remotely.
- Local Visualization: ROOT or Matplotlib for efficient, flexible, and highly customizable visualization.



Applications



- **Reconstruct ~80MHz rawdata per second, and clustering photons to neutron.**
- **Transfer RawData to 3D histdata, compressed by two orders of magnitude.**



- **Receive detector rawdata and chopper metadata simultaneously.**
- **Reconstruct neutron events and correct Tof spectrum using chopper medata**

Conclusions

This paper presents NISDRP, a data stream processing software designed for neutron scattering experiments, tailored to the next-generation data transmission architecture at CSNS. By leveraging generalized, modular, and parallelized data readout and asynchronous processing, NISDRP enables real-time data analysis for various neutron detectors, choppers, and sample environment equipment. The platform uses a globally unified pulse index to aggregate data from different modules and devices, creating highly favorable conditions for in-depth analysis of instrument experiment data. The TPX3Cam data reconstruction on ERNI and the comprehensive data processing tests conducted on BL20 demonstrate that this software effectively meets the demands of high data volume processing and customized data analysis.

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