Streaming data processing for Multi-Parameter Phased Array Weather Radar (MP-PAWR) data

*Takeshi Maesaka[1], Kaori Kieda[1], Koyuru Iwanami[1], Nobuhiro Takahashi[2], Hiroshi Hanado[3], Katsuhiro Nakagawa[3], Fumihiko Mizutani[4], Tomoo Ushio[5], Masahiko Osada[6]

1. National Research Institute for Earth Science and Disaster Resilience, 2. Nagoya University, 3. National Institute of Information and Communications Technology, 4. Toshiba Infrastructure Systems and Solutions Corporation, 5. Tokyo Metropolitan University, 6. Saitama University

We developed a streaming data processing system to generate various products from observation data of Multi-Parameter Phased Array Weather Radar (MP-PAWR), which was installed at Saitama University, in real-time. The MP-PAWR, simultaneously acquires multiple elevation data for each azimuth angle (like RHI scan data), and gets volume data by azimuthal rotation of the antenna. The MP-PAWR has two observation modes: Mode 1 (observation range = 80 km, range resolution = 150 m, number of elevations = 77, highest elevation = 60 degree, antenna rotation speed = 1 rpm, for weather surveillance) and Mode 2 (60 km, 75 m, 114, 90 degree, 2 rpm, for scientific research). The data size output from the MP-PAWR is 260 MB /min. in Mode 1, and 1 GB/min. in Mode 2. Ordinary weather radar generates a data file after its antenna scan, such as PPI or RHI, finishes. The file creation in this manner causes a big delay in the product generation.
The MP-PAWR locates at Saitama University, and the data processing is done at National Research Institute for Earth Science and Disaster Resilience (NIED). These two points are connected with SINET5 (a Japanese academic network with 100 Gbps backbone). A TCP stream is always established between the MP-PAWR and processing system. The chunk of data which consists of multiple elevation data simultaneously observed by the MP-PAWR is immediately sent to NIED through the stream. The arrived data are stored in shared memory of processing server. Next data processing program searches the arrived data from the shared memory, and executes quality control, KDP estimation, attenuation correction, QPE calculation, and so on. This process is parallelized ray-by-ray and the results are also saved in the shared memory. The processed data are also scanned by an interpolation program which creates 3D gridded data, Vertically Integrated Liquid (VIL), and rainfall intensity near surface. These final products are generated in 10 seconds after the MP-PAWR volume observation is finished.The VIL and rainfall intensity data are sent to SIP4D (Shared Information Platform for Disaster management), which is cross-ministerial disaster information system for emergency response.
The MP-PAWR enables to acquire the three-dimensional polarimetric data in less than one minute; however its data are quite huge. So the MP-PAWR needs the higher-speed data processing not to spoil its advantages. The streaming data processing with parallel computing solved this problem to generate various rainfall products with a low latency.

Keywords: MP-PAWR, Data processing, Streaming, Parallel computing