Development of MicroTCA-based Image Processing System at SPring-8

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Abstract:

We have developed a new image processing system based on the MicroTCA platform, which has an advantage over PC in robustness and scalability. In order to reduce development cost and time, the new system is built with commercial off-the-shelf (COTS) products including a Camera Link FMC and a user-configurable Spartan6 AMC with an FMC slot. The Camera Link FPGA IP core is newly developed in compliance with the AMBA AXI4 open-bus to enhance reusability.

The MicroTCA system was first applied to upgrade of the two-dimensional synchrotron radiation interferometer operating at the SPring-8 storage ring. The sizes and tilt angle of a transverse electron beam profile with elliptical Gaussian distribution are extracted from an observed 2D-interferogram. A dedicated processor AMC that communicates with the primary processor AMC via backplane is added for fast 2D-fitting calculation to achieve real-time beam profile monitoring during the storage ring operation.

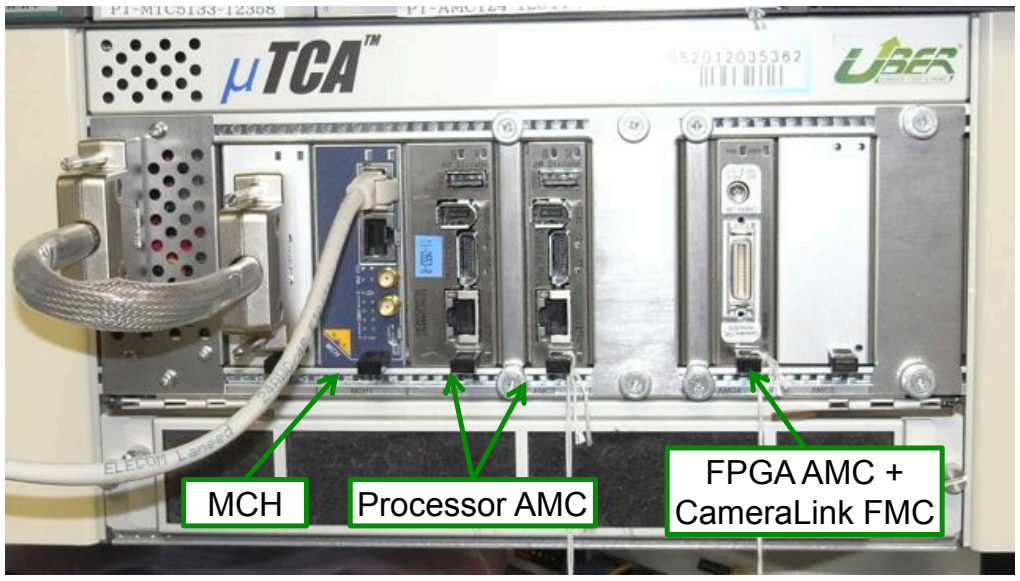


Image Processing System

MicroTCA

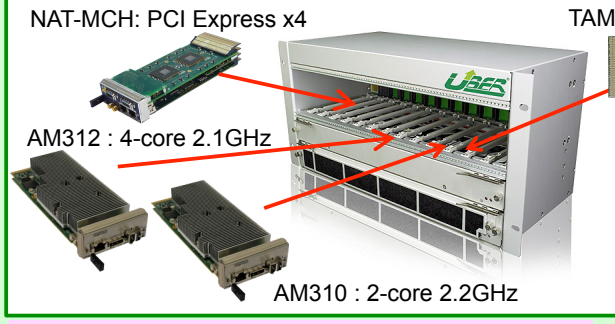
- High reliable, flexible, scalable and compact solution
- Switch-based platform with high-speed serial link
- Available Multi-Processor configuration through fast bus
  - ➢ realize distributed processing

Device Components :
All devices are commercial off-the-shelf (COTS) products

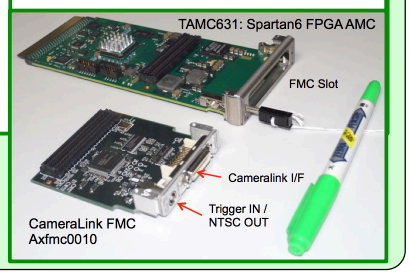
NAT-MCH: PCI Express x4

FC320CL
VGA, Max 30fps

TAMC631+Axfmc0010



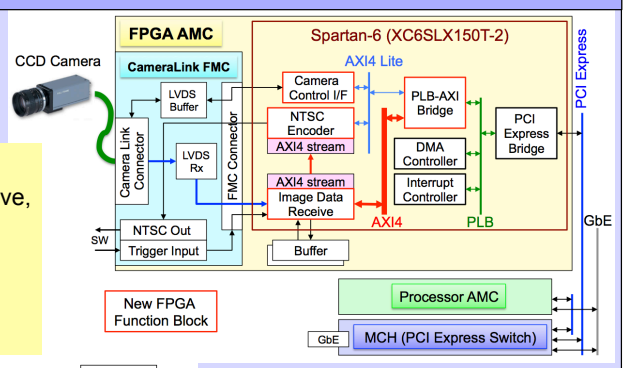
Develop FPGA IP core and Linux driver/Library



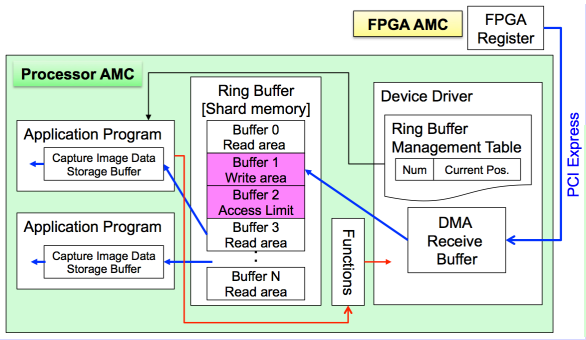
Standalone Performance
- **100 Hz @continuous trigger mode**
- **60 Hz @external trigger mode**

Development

- MicroTCA Camera Link system



Camera Link FPGA IP Core
- Camera control, Image data receive, NTSC encoder, PLB-AXI Bridge
  - ➢ connect to AXI4 open bus
- Double buffer on DDR3 memory
- Trigger counter for synchronized image data acquisition

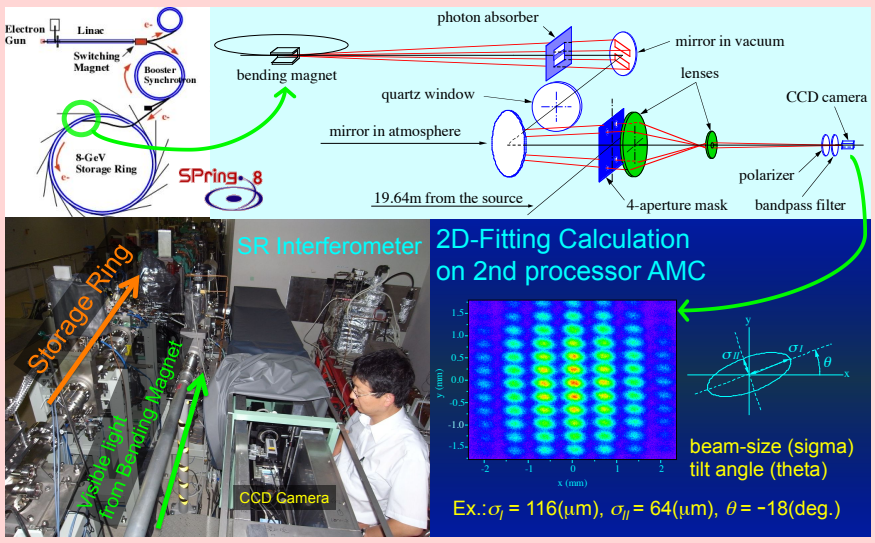


Linux Driver and Library
- work on CentOS 6.3
- Ring Buffer
  - ➢ to realize parallel processing
- DMA transfer
- Library for user application
  - ➢ camera control, board setting

Application for the Synchrotron Radiation Interferometer

Requirements

- Real-time measurement of beam sizes and beam-tilt angle
  - ➢ The results are written to database in a 1 Hz cycle
- Live-view



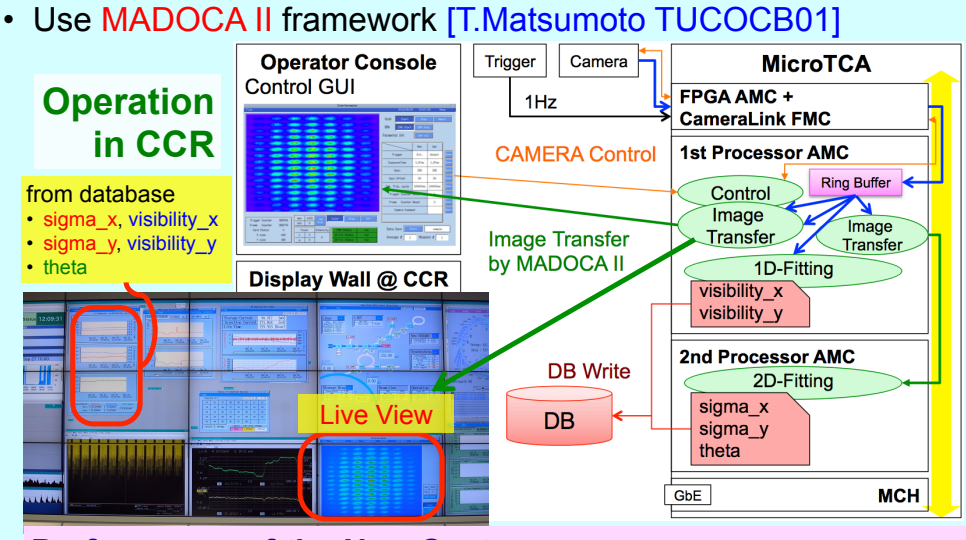
M. Masaki & S. Takano, J. Sync. Rad. (2003). **10**, p295

Control System Configuration

- 2 processor AMCs for distributed processing
- Use MADOCA II framework [T.Matsumoto TUCOCB01]

Operation in CCR

from database
- sigma_x, visibility_x
- sigma_y, visibility_y
- theta



Performance of the New System
- **Live-view display worked up to 10 Hz trigger rate**
- **Beam size and tilt angle by 2D fitting calculation : ~0.5 sec**

Summary:

We have developed an image processing system based on the MicroTCA platform. The Camera Link FPGA IP core is newly developed using COTS products including a Camera Link FMC and a user-configurable FPGA AMC. A Linux device driver and library were also developed.

This MicroTCA system has been applied to upgrade of the image processing system for the two-dimensional SR interferometer. We realized real-time measurement of the beam sizes and the beam-tilt angle by fast 2D fitting calculation using multiple processor modules.