LCLS Undulator Positioning Control System

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Outline

- Undulator Positioning Control System Hardware
- Field IOC Hardware
- Network Scheme
- IOC Software
- EPICS Database
- EPICS SmartMotor driver
- User Graphic Interface: MEDM vs Java
- Things to do
Undulator Positioning Control System Hardware and Requirements

- LCLS has 33 undulator segments, each segment has a positioning system that consists of:
  - 5-axis girder cam mover system
  - 2-axis undulator translation system
  - 5 absolute angular position readouts
  - 8 absolute linear position readouts
  - Total: 231 motion axis and 429 position feedbacks
  - Each segment has one IOC

- Quadrupole Motion Positioning Repeatability ±7 μm
- Short-Term (1 h) BPM and Quad Stability ±2 μm
- Long-Term (24 h) BPM and Quad Stability ±5 μm
- Thermal limitations
- CAM mover system has five degrees of freedom
  - X-translation
  - Y-translation
  - Pitch motion
  - Roll motion
  - Yaw motion
Field IOC Hardware

  - 16 channel single ended/8 differential ADCs (16-bit) for position readouts.
  - Programmable input range: ±10V/0-10v
  - 24 programmable digital I/O
- One Ethernet port, and 12 serial ports, including add-on 8 channel serial port board for motion control:
  - Configurable RS232, RS422, RS485
- 32M flash disk; IDE driver connector
- Two USB ports, one parallel port
- Floppy disk driver connector
Network Scheme

- 33 IOCs with a DHCP/NFS server
- On each IOC:
  - scp for file copy
  - sshd for remote login
  - dhclient for dynamic IP address configuration
- IP address setup scheme
  - Run dhclient, if success, save IP address in a script.
  - Otherwise, run the pre-saved script.
  - If no pre-saved script exists, run the default script.
IOC Software

- Linux 2.4.22: boot from local flash disk
  - IOC kernel and application program are updated through scp command from the server as needed.
- EPICS base 3.14.8.2
- ASYN 4-4
- Device/driver support for the ADC/DIO on CPU board
- Kernel module for the 8 channel serial port PC104 board
- Motor record and SmartMotor driver support
- EPICS database
SmartMotor driver support

  - http://www.animatics.com/
- Motor record and device support
- Based on Intelligent Motion System’s IM483 driver
EPICS Database

- PV naming scheme: prefix of PV name is assigned according to the last 8 bits of IOC’s IP address, e.g.
  - IP: xxx.xxx.xxx.101 → id001:xxxx
  - IP: xxx.xxx.xxx.133 → id033:xxxx
- Motion Algorithms are implemented through calc records.
MEDM User Interfaces

- Position Control
- Undulator Position Control
- Undulator Position Calibration
- Girder Position Control
- Girder CAM Position Calibration
- Girder Parameter
- Potentiometer Readout
- Motor setup (7)
MEDM User Interface

LCLS SEGMENT NUMBER 001
Position Control

Please check if ID motors stoped or comm failed

LCLS SEGMENT NUMBER 001
Undulator Position Control

Please check if ID motors stoped or comm failed

LCLS SEGMENT NUMBER 001
Girder Position Control
### MEDM User Interface

#### LCLS SEGMENT NUMBER 001

**Girder CAM Position Calibration**

<table>
<thead>
<tr>
<th>CAM #</th>
<th>CAM #1 (deg)</th>
<th>CAM #2 (deg)</th>
<th>Zero Offset (deg)</th>
<th>Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>196.8/39</td>
<td>196.8/39</td>
<td>196.8/39</td>
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<tr>
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<td>162.5/513</td>
<td>162.5/513</td>
<td>162.5/513</td>
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<tr>
<td></td>
<td>163.7/538</td>
<td>163.7/538</td>
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<td></td>
<td>165.2223</td>
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<td>165.2223</td>
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#### LCLS SEGMENT NUMBER 001

**Girder Parameters**

<table>
<thead>
<tr>
<th></th>
<th>X1 94 (mm)</th>
<th>X2 (mm)</th>
<th>X3 1375 (mm)</th>
<th>Y (mm)</th>
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<tbody>
<tr>
<td>X1 (mm)</td>
<td>225.1000</td>
<td>225.3000</td>
<td>330.2500</td>
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<td>X2 (mm)</td>
<td>1.5000</td>
<td>1.5000</td>
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<tr>
<td>X3 1375</td>
<td>1.5000</td>
<td>1.5000</td>
<td>3.5000</td>
<td>3.5000</td>
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<tr>
<td>Y (mm)</td>
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#### LCLS SEGMENT NUMBER 001

**Girder Linear Position Calibration**

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<th>UNHANS L/H/AM</th>
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<th>Zero Offset (cm)</th>
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<td>X</td>
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<td>0100.0000</td>
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<tr>
<td>Y</td>
<td>5110.4382</td>
<td>3000.0000</td>
<td>0100.0000</td>
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<tr>
<td>Out Y</td>
<td>4935.8746</td>
<td>3000.0000</td>
<td>0100.0000</td>
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#### LCLS SEGMENT NUMBER 001

**Potentiometer Readout**

<table>
<thead>
<tr>
<th></th>
<th>CLL CAM#1</th>
<th>CLL CAM#2</th>
<th>CLL CAM#3</th>
<th>CLL CAM#4</th>
<th>CLL CAM#5</th>
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<tbody>
<tr>
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<td>5.9413</td>
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<td>CAM Posy</td>
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<td>Y</td>
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<td>9200.1100</td>
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</tbody>
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**Note:** The diagrams and tables illustrate the setup and calibration processes for components of the MEDM system, focusing on specific configurations and settings.
Java User interface

- Eclipse 3.1 IDE on Linux
- Visual Editor
- Jca 2.16 CA library
- RCP (Rich Client Platform)
- Manage the control and display of all the undulators in one window
GUI (Java version)
GUI (Java version)
Things to Do

- EDM GUI
- System verification on SUT (Single Undulator Test) system
- Network verification
- Undulator motion control design review
- Integrate software into source/release controls system at SLAC (subversion).
- Determine operator/engineering interfaces required for LCLS operation.
Thank you for your attention