

# Piezo Open Loop ?

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# Piezo Open Loop

- The challenge:
  - Shape neutron beam close to the sample:  
"slit system"
  - No magnetic material
  - Mechanical small construction
- Proposed solution: 2 Piezo "motors"

# Proposed solution

- Piezo Positioner
  - High resolution possible
  - Build in feedback system (pico meter)
- Positioning depending on
  - Forward vs Backward
  - “Step mode” vs “stretch mode”
  - Temperature
  - Step frequency
- Handled by the by the feedback (sensor)

# The plan

- The plan:
  - SmarAct stage + SmarAct controller:  
(Provide 0...100V to stage,  
close loop via sensor  
error handling
- SW interface ?

- SmarAct can use 2-3 interfaces:
  - EtherCAT (session yesterday)
  - Can be integrated into TwinCAT as a "motor/drive" and become a TwinCAT axis.
- Same integration into EPICS as stepper/servo MotorRecord (for users)  
+ some Pvs (calibrate, status)
- Use existing model 3 driver: ethercatmc

- Ethernet:
  - connect to your LAN
- IOC Software:
  - Use a Linux library/API, c++  
(or)
  - Use ASCII strings.

EPICS motor model 3 driver exists, yes.
- Other software: Tool from vendor (Windows)

# The first steps

- (Done at in-kind partner):
  - Run the SmarAct through EtherCAT and TwinCAT
  - Worked well until...
    - The sensor died
- Other solution needed

# Introducing the potentiometer

- New concept:
  - SmarAct Controller via  
epics-motor/.../motorSmarAct  
(Ethernet with ASCII)
  - Mechanical position reading: Potentiometer  
analog input into an EtherCAT terminal
- Close the loop at the end of the movement:  
MotorRecord:
  - retry logic

# Readback via poti

- Potentiometer → analog input  
Can read physical position →  
EPICS ai record
- Smaract (driver) : Different bits/bytes:
  - Disable sensor
  - open loop
  - Step size forward, backward
- MotorRecord: set up fields for external readback

# MotorRecord Closed Loop

- `field(URIP, "$(URIP=1)")`
- `field(RDBL, "$(P)$ (M)PosRB")`
- `field(RDBD, "$(RDBD=0.01)")`
- `field(SPBD, "$(RDBD=0.01)")`
- `field(RTRY, "$(RTRY=7)")`

# CSS for piezo motor

Name: BIFRO-SpSl1:MC-SlYm-01:PzMtr    PV: BIFRO-SpSl1:MC-SlYm-01:PzMtr    Mot. Vers: 7.28 mm

### Status

Motor Status Bits - MSTA

- Positive Dir
- Done Moving
- High LS
- Home LS
- N/A
- Closed Loop
- Slip/Stall (Following Err)
- In Home Pos
- Encoder Present
- Hw Problem
- Moving
- Supports ClosedLoop
- Comm Error
- Low LS
- Homed

**Other bits**

- LVIO
- URIP (Use Ext.)
- MISS
- CNEN

STAT: NO\_ALARM

MIP

### Operate

Status: Not Moving

No Sevr    No Alarm

RBV: 0.000000 mm

RBV Src: Intern    Internal

Target: 0.000000 mm

User Lims: -11.500000    4.000000

Homing: HOMR    HOMF

Jogging: JOGR    JOGF

Step Ctrl: < 1.000000 mm >

Msg

STOP

### Motor Record Params

ACCS	10.000000 mm	10.000000 mm
ACCL	0.100000 sec	0.100000 sec
VELO	1.000000 mm/s	1.000000 mm/s
JVEL	1.000000 mm/s	1.000000 mm/s
LLM	-11.500000 mm	-11.500000 mm
HLM	4.000000 mm	4.000000 mm
OFFS	0.500000 mm	0.500000 mm
RTRY	5	5
RCNT	0	
<b>Dial</b>		
	<input checked="" type="checkbox"/> SET	<input type="checkbox"/> FOFF
DVAL	-0.500000 mm	-0.500000 mm
DRBV	-0.500000 mm	
DLLM	-12.000000 mm	-12.000000 mm
DHLM	3.500000 mm	3.500000 mm
RVAL	-500000 mm	-500000 mm
RRBV	-500000 mm	

# Piezo motor, part 2: SmarAct

### SmarAct Controller

Calib/Ref:	<input type="radio"/> Calibrated <input type="radio"/> Referenced	Loop State	Closed		<input type="checkbox"/> Busy	<input type="checkbox"/> Mov. Failed
Calibrate	<input type="button" value="Calibrate"/>	Sens Pwr Mod	PowerSave		<input checked="" type="checkbox"/> Closed Loop	<input type="checkbox"/> Streaming
Encoder	-0.500001 mm	Step Cnt.	0		<input type="checkbox"/> Calibrating	<input type="checkbox"/> Posit. Overload
Exptd. Pos.	-0.500000 mm	Step Size (F)	0.002910 mm	0.002910 mm	<input type="checkbox"/> Referencing	<input type="checkbox"/> Overtemp
Mtr Pos (Done)	-0.500000 mm	Step Size (R)	0.003400 mm	0.003400 mm	<input type="checkbox"/> Move delayed	<input type="checkbox"/> Ref. Mark
External RBV	-0.50137661 mm	Step Freq.	0	0	<input checked="" type="checkbox"/> Sens. Present	<input type="checkbox"/> Phased
Max Ctrl L. Frq.	<input type="text" value="5000 Hz"/> <input type="text" value="5000 Hz"/>	Hold Time	-1 ms	-1 ms	<input checked="" type="checkbox"/> Calibrated	<input type="checkbox"/> Posit. Fault
Posit. Typ	CT002/AT002	Pwr Save Dly	100 ms	100 ms	<input checked="" type="checkbox"/> Referenced	<input checked="" type="checkbox"/> In Position
					<input type="checkbox"/> End Stop Rchd.	<input checked="" type="checkbox"/> Amplif. Enbld.
					<input type="checkbox"/> Range Limit Rchd.	<input type="checkbox"/> Brake Enabled
					<input type="checkbox"/> Follw. Limit Rchd.	

- Many improvements to motorSmarAct  
pull request delayed due to many  
merge conflicts
  - Never use TAB in your source code.
  - Formatting tools ?
- Simulator written in rust
- Automated tests: No (not yet ?)

- Summary:
  - Disabling sensor is possible
  - Open loop becomes closed loop with external readback and retry logic in motorRecord