Documentation for Motion and Beamline Control for Scienta

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Installation of Manipulator and Monochromator Controls

In order to use user interfaces such as the Motion Control Interface, and the Monochromator Control Interface one must use a version of SES 1.2.2 or greater. Gamma Data provides the above mentioned interfaces, but libraries must be written to communicate with the hardware for these interfaces to be functional.

One should first launch SES. Select Setup=>User Interfaces…=>Add (now add both Manipulator.dll and Monochromator.dll which should be in the SES “dll” folder and are provided by gamma data—if they are not there, find them and move them to the “dll” folder). Close SES.

The simplest way to install the rest is to do the following. First, the proper dll’s and .ini files must be copied to the proper locations. The SES software has a “dll” folder. This folder must contain a Gamma-Data supplied “Manipulator.dll” and “Monochromator.dll” files, as well as four SRC-supplied Manipulator and Monochromator Hardware Library dll’s. Currently the most updated SRC-provided dll’s are ***********insert file names here***********. The SES software also has an “ini” folder for initialization files. Copy the “Monochromator.ini”, “CurrentPosition.ini”, “CalibDefVelLimit.ini” and “Manipulator.ini” text-files (whose text is found in the appendix) into the SES “ini” folder.

Now when one launches SES, manipulator and beamline control should be initialized and functional.

Using the Software

General

To start SES properly one should do the following steps.

1. Make Sure Cables are attached properly
    a. 3 limit switch cables (XYZ)
    b. 2 encoder cables (Z and Rotation)
    c. 4 motor cables
    d. Null Modem Cable connection to Slave computer
    e. 2 m cable connection from NI Motion Card (pci card in computer) to UMI
    f. UMI connected to NEAT via 25 pin ribbon cable
2. Turn on the NEAT Controller
3. Make sure slave computer is in “slave mode” (if using slave control).
4. Launch SES

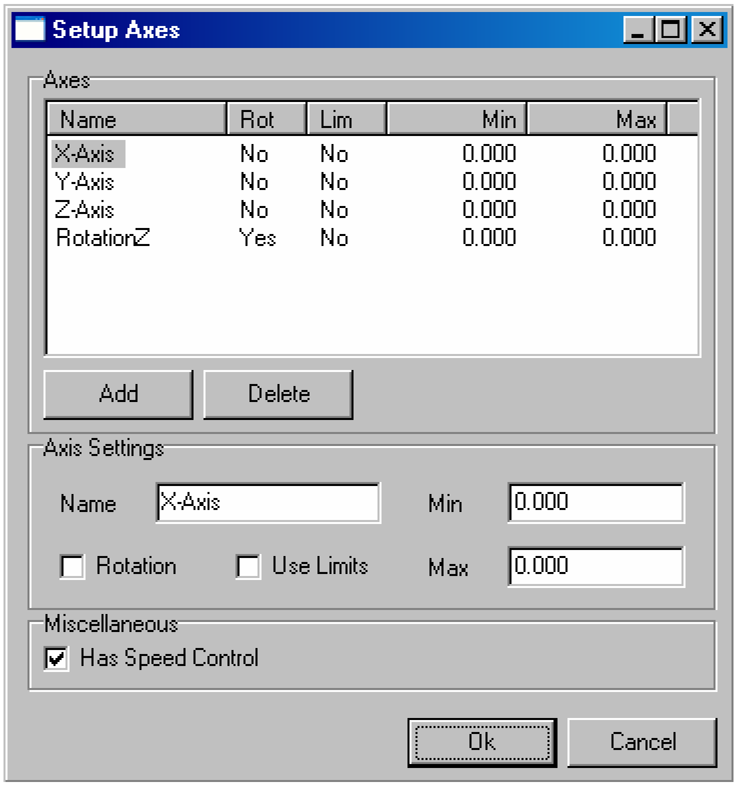
To Shutdown SES one should do the following steps.

1. Close SES
2. Turn off NEAT Controller (this allows the motors to cool).

Manipulator Control

After completing the installation the SES program has a new menu option “Manipulator.” The sub-menu options do the following:

Setup: Allows the user to select different SRC-provided Manipulator Hardware Libraries and allows the user to set up the Axes using the “Setup” option. The “Setup Axes” window should appear as in the following figure (if not modify it to look as the figure does). The limits are programmed into the software, but the min/max settings can be set to give a general idea of the range of motion available. Since the limits are programmed into the software directly (not user-settable) the Use Limit option should not be selected. When the “has speed control” option is selected, the user will be able to select the velocity at which axes move (axes move at a default velocity when this option is not selected).



Name	Rot	Lim	Min	Max
X-Axis	No	No	0.000	0.000
Y-Axis	No	No	0.000	0.000
Z-Axis	No	No	0.000	0.000
RotationZ	Yes	No	0.000	0.000

Name X-Axis

Min 0.000

□ Rotation □ Use Limits

Max 0.000

☑ Has Speed Control

Manual Control: Allows the user to select a movement to a pre-defined position, or move to a user-desired position. When “has speed control” option is selected, the speed at which movements occur can be set by the user. Using ‘0’ for velocity yields a move at the default velocity. The default velocities should be used in almost all cases. Using other velocities may result in damage to the system, or cause the motors to slip.

Edit Positions: Set up the Coordinates for common positions and give them a name!

Show Position: Shows the current position

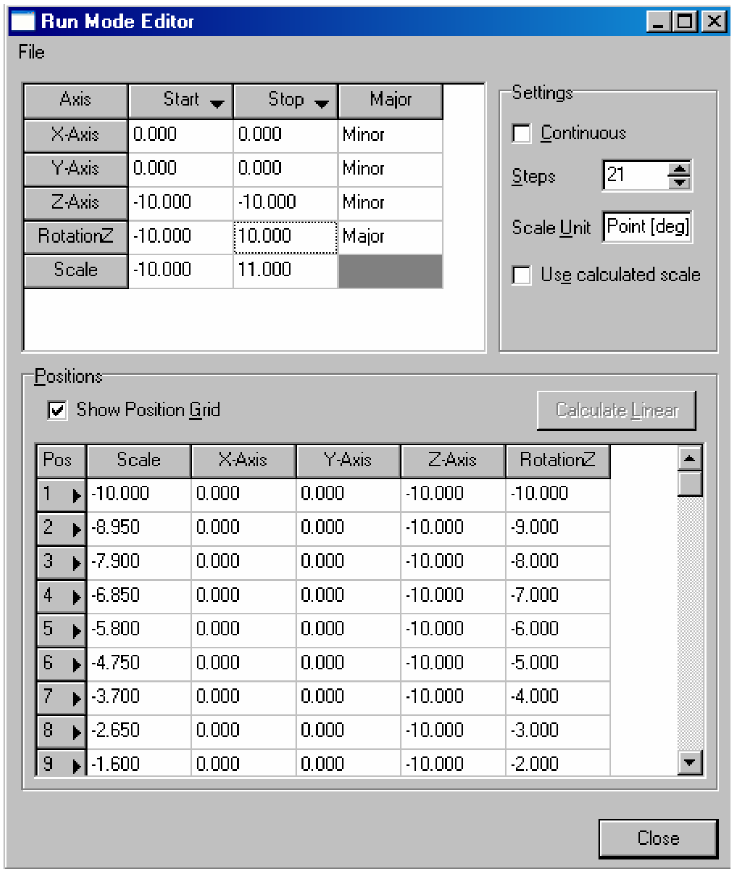
When performing a move a window appears showing the current position, the destination, and the option of stopping the motion. The motion can be stopped by either pressing a key, or by clicking the stop button. The motion can then either be aborted, or resumed.

Currently X, Y, Z axes motion don't implement an overshoot. For the Z-Rotation axis, however, the sample sometimes over-shoots the selected position so as to approach the position always from the same side. This feature should eliminate any variation in actual sample position for the Z-rotation axis that may arise by approaching the position from different directions.

MANIPULATOR SCANS

The addition of Manipulator control allows the user to perform Manipulator scans and giving an additional dimension to stored data. These manipulator scans are implemented in the "Run => Setup" menu. This opens what is called the sequence menu. Here you have the option of creating sequences and allows you to run these sequences for different manipulator positions (thus adding an additional dimension to the data).

In order to set up the Manipulator scan select (or create) a region with your desired parameters. Then select Manipulator Scan from the Run Mode dropdown window. Now click edit to enter the Manipulator Scan setup window. This window looks as follows.



Axis	Start	Stop	Major
X-Axis	0.000	0.000	Minor
Y-Axis	0.000	0.000	Minor
Z-Axis	-10.000	-10.000	Minor
RotationZ	-10.000	10.000	Major
Scale	-10.000	11.000	

Settings

☐ Continuous

Steps 21

Scale Unit Point [deg]

☐ Use calculated scale

Positions

☑ Show Position Grid

Pos	Scale	X-Axis	Y-Axis	Z-Axis	RotationZ
1	-10.000	0.000	0.000	-10.000	-10.000
2	-8.950	0.000	0.000	-10.000	-9.000
3	-7.900	0.000	0.000	-10.000	-8.000
4	-6.850	0.000	0.000	-10.000	-7.000
5	-5.800	0.000	0.000	-10.000	-6.000
6	-4.750	0.000	0.000	-10.000	-5.000
7	-3.700	0.000	0.000	-10.000	-4.000
8	-2.650	0.000	0.000	-10.000	-3.000
9	-1.600	0.000	0.000	-10.000	-2.000

Notice in the above figure, that you can specify start and stop positions for all axes, and the number of steps to make while stepping. The actual coordinates that will be used are shown in the table or grid. In this case, the first scan will occur when the manipulator is at X = 0, Y = 0, Z = -10 and Rotation = -10. After the first scan is completed the sample will be moved to position 2 where X = 0, Y = 0, Z = -10 and Rotation = -9. This will be repeated until all 21 positions are done.

One nice feature is the ability to manually edit entries in the table. This is nice when the sample isn't exactly aligned, thus causing the sample to slowly drift as one rotates the sample. This drift is often undesirable, and movements in X and or Y must be made to make sure that one measures the same spot on the sample under varying rotations. What a user could do is optimize the counts for three or four rotation values spanning the desired range, plot the x and y positions as functions of rotation, fit the data, and then enter in the fit values in the appropriate places in the grid.

Finally a WORD OF CAUTION !!! Make sure that you double check each of the positions, because the manipulator will move to the positions in the grid. An example of this is as follows. If the user wants to rotate the sample during the scan, it is easy to simply set the starting angle, and finishing angle with the number of steps (not making sure to also set the x, y and z positions). The user would first maximize counts by adjusting x, y and z then start the scan. If the x, y, and z values in the grid aren't the same as the x, y and z values from the maximization, after starting the scan the sample will be moved to the location in the table possibly throwing off the maximization.

Finally, the ADDED DIMENSION will be in units the major axis. In the above figure, the major axis is the rotational axis with units of (deg). Make sure that the major axis is set correctly in order to fully utilize the capabilities of the data acquisition

DEFINITION OF LIMIT RESTRAINTS

We have the following limits for the system. The system can't go above Zmax=-5, or below Zmin=-475. Between Zmax and Zmin we have ZShutter above ZValve. When the manipulator is above ZShutter the manipulator can be rotated between PosRotUpper=270 and NegRotUpper=-40. When the manipulator is below ZShutter then the manipulator can be rotated between PosRotLower=110 and NegRotLower=-40. When you move the manipulator from above the ZShutter to below ZShutter the manipulator should be at zero degrees, and it should not rotate as one goes down. Furthermore, if one is below ZShutter and moves above ZShutter no rotation should take place. Finally, the range that the manipulator can travel from the X=0 and Y=0 is XYRangeAnalyzer=15.0 and XYRangePrep=16.0.

************************Authorized Users ONLY!!!***********************

DEFINING CURRENT POSITION

To change the value of the current position without moving the manipulator (or possibly to set the position to "zero", one does the following).

1. Move the Manipulator to the desired position
2. Close SES
3. Open "CurrentPosition.ini" in the ini folder of the SES software
4. Find [Initial Positions] and change the following

   X-Axis=______
   Y-Axis=______
   Z-Axis=______ Set the values to whatever you want
   RotationZ=______
5. Save "CurrentPosition.ini" and close
6. Relaunch SES, and check the positions. They should now correspond to what you saved in the file.

WARNING!!!
NOTE!!!!!!!!!!
VERY IMPORTANT!!!!!

Changing the initial positions may require that you redefine the limits accordingly, by changing the following in "CalibDefVelLimit.ini"

```
[Manipulator Limits]
XYRangeAnalyzer=15.0
XYRangePrep=16.0
Zmin=-470.0
ZValve=-80.0
ZShutter=-63.0
Zmax=-5.0
PosRotUpper=270.0
NegRotUpper=-40.0
PosRotLower=110.0
NegRotLower=-40.0
PosTransferRot=3.0
NegTransferRot=-3.0
```

SETTING THE DEFAULT VELOCITY

1. Close SES
2. Open “CalibDefVelLimit.ini”
3. Find the following and change the velocities to that desired.

```
[Default Speed]
X Velocity=0.5
Y Velocity=0.5
Z Velocity=3.7
RZ Velocity=3
```

4. Save “CalibDefVelLimit.ini” and close
5. Relaunch SES

CALIBRATING THE MOTOR STEPS PER UNIT

1. Close SES
2. Open “CalibDefVelLimit.ini”
3. Find the following and change the calibration to that desired

```
[Calibration Steps/Unit]
X Steps/mm=1569.0
Y Steps/mm=1569.0
Z Steps/mm=7874.0157
RZ Steps/deg=1000.0
```

4. Save “CalibDefVelLimit.ini” and close
5. Relaunch SES

Great care should be exercised when changing the calibration since that could throw off the limit values above, as well as velocities, and so forth. It is my opinion that the calibration given is sufficiently accurate that no changes should be necessary!

****

Crash Recovery and General Crash Tips

SES seems to run better when few if any programs are run in the background, so I recommend running as few additional programs as possible.

If the program crashes during a movement, don't immediately kill the program. First make a few notes. First, check the last position read (probably won't help much, but it may) and Second, check the destination. This last value could be very useful. Once the SES software sends out a motion command to the NI card, the card runs the rest (even if SES crashes). What does this mean? It means that the card will continue to function moving the manipulator to the requested position. There is one slight nuance to this, however, namely, that the Z and Rotation positions will be moved 99% of the way. By comparing the last stored value (in "CurrentPosition.ini") and the destination noted before SES is killed one should be able to quite accurately determine the manipulator location. The good news is that SES won't let you begin a move that would take you out of range, so even if the program crashes the motors should stop moving before a catastrophe can happen.

As an example of how to recover after a crash let's take the following case. Let's say I've just completed a move to the following coordinates: X = 0, Y = 0, Z = 0 and Rotation = 0. The move is completed and this coordinate is saved in the "CurrentPosition.ini" file. I now begin a move where my destination is X = 10, Y = 10, Z = 100 and Rotation = -98. In the course of the movement SES crashes. Not panicking, I let the motors run their course. I'm careful to watch the motion to make sure nothing gets damaged. If I see that something is going to be damaged if I don't stop the motion, then I would kill the motion by using "EmergencyStop," a program that runs independently of SES (see next paragraph for more details). But in most cases, "Emergency Stop" doesn't need to be used and the motors will come to a rest. I now check the destination and write that down. I can then kill SES. At this point, I would open the "CurrentPosition.ini" file, and write down the last position I was at. If for some reason this Current Position looks fishy, skip to paragraph about the "CrashRecovery" program. Now by doing some simple math, I would determine that the manipulator is currently at X = 10, Y = 10, Z = 99 and Rotation = -99. Now you might wonder why the rotation would be at -99, and not at -97.02. The reason for this is when rotating in the negative direction there is a 2 degree overshoot (note, this is only in the negative direction, if the destination were +98 then the manipulator would be at +97.02 when it comes to a rest). Once it overshoots it then moves the sample to the desired location. The first move then, in our case was to go to 99% of -100, or -99 degrees. I would then change the CurrentPosition.ini file to contain the actual location of our sample, namely X=10, Y=10, Z=99 and Rotation=-99. When I then restart SES, the current position should be correct, and I should be back in business.

Additional safety back-ups: Also provided is a program called "Emergency Stop." This Labview based program can run in the background, and if SES crashes for some reason, and the move needs to be aborted you can do so by pressing the large button called “stop” (it’s better and easier to recover from a crash if you let the move finish and then determine the final position as explained in the previous paragraph). In order to use this program open the LabView VI called “EmergencyStop” start the program, and let it run in the background. A few things to note: PRESSING STOP while SES is running well will cause SES to crash, so while SES is running stopping the motion through SES is the preferred method. IF Emergency Stop is used, and the stop button has been pressed, then you can kill SES. Once SES has been killed and the motion has stopped press the button called “Motion Stopped SES closed.” This button must be pushed in order to do re-initialize the motors. Before this button is pushed, or if Emergency Stop is closed before this button is pushed, the motors will remain in a disabled state preventing any motion from occurring. If you forget to push this final button, you must again start Emergency Stop, press Stop, and then press “Motion Stopped SES closed.” The motors should then be good to go.

“CRASH RECOVERY” Program.

This program can be used in any circumstance to determine the current position. It can be used in place of the example given above as well, but may take up to 20 minutes to complete. This program should ALWAYS be used when you aren’t sure when/how SES crashed, when you’re not 100% certain that you know the beginning position and the destination position.

Crash Recovery works as follows. First the user is to rotate the manipulator so it reads zero. Remember, to always approach zero from the negative side. For example, if I am currently at three degrees and I want to go to zero I would do the following. I would rotate the sample -5 degrees (bringing me to -2). I would then rotate the sample +2 degrees bringing me to zero. This overshoot need not be done when rotating the other direction.

Once the rotation is zeroed, press the “Rotation Zeroed” button. This will then enable you to begin the automated centering of the X, Y, and Z axes. To begin this press the button called “Center X, Y, Z start” The method used for centering these axes is as follows. First the x-axis is moved forward until it hits a limit switch, it then moves back until it hits a limit switch and then it moves to the center point of the two switches. This process is repeated for the Y and Z axes.

At any time while running this program you can hit stop to kill the motion and stop the program. After hitting stop I recommend closing the program, opening it, and restarting it before you run it a second time.

Before beginning the centering process, I also recommend that you check the placement and functionality of the limit switches. To check the placement make sure that the switches are in the proper location, and to check the functionality of the switches I recommend you use the Measurement and Automation Explorer (MAX). To use MAX, click on Devices and Interfaces=>Your Motion Card=>Interactive=>1-DInteractive.

This will open a simple window where you can see if a limit switch is active. Trigger each limit switch manually and make sure that the LED is activated in MAX corresponding to that limit switch. Once you are sure all switches are functioning you can continue with the centering process.

After the Crash Recovery Program is completed, you should enter in the position into the "CurrentPosition.ini" file. The coordinates that you should enter are X=0.0, Y=0.0, Z = -238.84 and Rotation = 0.0. Save the file, and then when you restart SES you should see that SES says you're at the correct location.

You should not run Crash Recovery while SES is running.

Monochromator and Beamline Control

After completing the installation the SES program has a new menu option "Monochromator." The sub-menu options do the following:

Setup: Allows the user to select different SRC-provided Manipulator Hardware Libraries and select what method of beamline control one wishes to uses. By clicking the setup button there are several options. Here one can select which beamline the user is using, the com port for the connection (use com1 typically), whether or not one wants constant slit widths (the opposite being constant resolution), manual control of the beamline (where one changes energy etc from the beamline computer), the photon energy, the resolution, the entrance slit, and the exit slit. For optimum performance on the PGM beamline the entrance slit should be 1.7 times that of the exit slit.

Manual Control: Here one can change the photon energy. If the library is running in constant slit mode then the slits remain unchanged, the resolution is changed, and the photon energy is changed. If, however, you are not in constant slit mode the energy will be changed, and the slits will be adjusted to result in a constant resolution.

Edit Positions: Here the user may name and define commonly used photon energy values.

While sending a command to the slave computer a window is displayed. There is a status box informing the user of the status of the communication. The first status is simply a "please wait" status. This informs the user that the computer is waiting for the proper response from the slave computer. This action should be virtually instantaneous so if you get a simple "please wait" status that persists you should probably hit the stop button, thus aborting attempted communication. If the status changes quickly to "some command, Please wait" then communication is working, and patience should be exercised (and, at this point you can't abort the action with the stop button).

If you abort the communication and wish to establish communication then you should verify that you have the correct COM settings, and that the null modem cable is connecting the two computers. You should then close SES, make sure that the slave computer is in "Slave Mode" and then you should relaunch SES. This clears the serial buffer, enabling proper communication with the slave computer.

While operating in "Manual Beam Control" mode no communication with the slave computer is necessary. If a window appears indicating that communication is trying to be established with the slave computer simply hit the "stop" button, and proceed.

NOTE!! You should always send a set energy command to the slave computer after injections since the Undulator and Monochromator are sometimes parked during injection. This will again set the energy to the desired value.

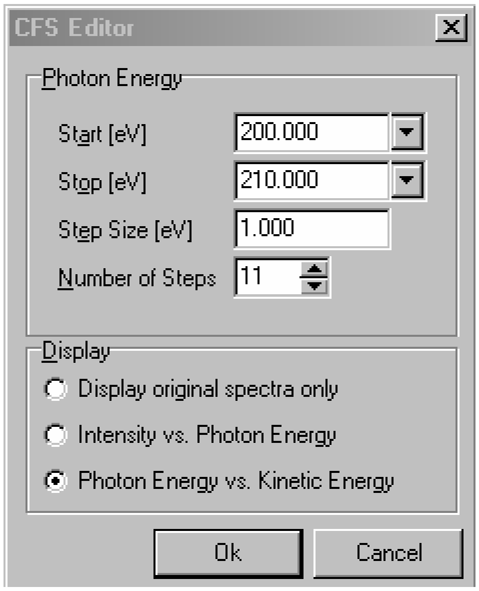
MONOCHROMATOR SCANS (CIS AND CFS)

There are two run modes (found in the Run=>Setup) sequence window which can be used to scan the monochromator. They are named CIS (Constant Initial State) and CFS (Constant Final State) and these can be used to scan the monochromator even if one is not actually doing CIS or CFS measurements.

Both run modes acquire spectra for a set of photon energies, and they are stored in the same way as for the Add Dimension run mode, i.e. they are stored as individual layers in the resulting spectrum file.

The difference between CIS and CFS is, as you may know, that for CIS the binding energy is kept constant while for CFS the kinetic energy is kept constant. Thus, for a measurement which would combine Add Dimension with a scan of the monochromator, CFS should be used.

The Setup windows for the CIS and CFS run modes are shown below, and their functionality is quite simple. You can adjust either the step size, or the number of steps (both are connected), and you can set the starting energy and the final energy.



Photon Energy

Start [eV] 200.000

Stop [eV] 210.000

Step Size [eV] 1.000

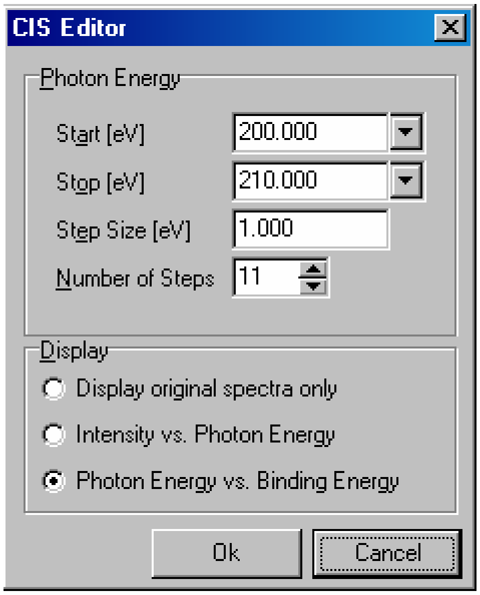
Number of Steps 11

Display

○ Display original spectra only

○ Intensity vs. Photon Energy

● Photon Energy vs. Kinetic Energy



Photon Energy

Start [eV] 200.000

Stop [eV] 210.000

Step Size [eV] 1.000

Number of Steps 11

Display

○ Display original spectra only

○ Intensity vs. Photon Energy

● Photon Energy vs. Binding Energy

HARDWARE

NEAT Controller

Our NEAT controller has three internal power supplies which power six axes. Since the Z and rotational axes require large, high-power motors, each of these motors must use a single internal power supply. To do this attach the X, Y, and Z motors to their respective axes on the NEAT controller. For the Rotation motor, attach it to the U axis on the NEAT controller. By doing so the Z and Rotational motors use their own power supplies. The NEAT controller uses a four outputs. These outputs are wired on pins 1,6,4 and 9. See Manual for pinout.

Our NEAT controller only has four lead outputs (pins 1 and 6 for phase one and pins 4 and 9 for phase 2). This controller **does not** use the older, but commonly used center-tapped wiring scheme.

The NEAT controller allows you to change the motor current and holding current by selecting the proper resistors for each axis. Instructions on doing this are found in the manual for the NEAT controller. The X and Y axes are currently using the factory default resistors, but the Z and Rotational axes utilize much higher current (7A) thus a different resistor), and a jumper is in place (on idle current) to reduce the holding current as much as possible when the motors are idling. Even with this current reduction the motors remain quite warm. The case temperature while idling seems to reach a steady state at about 70 C. In no case should the motor case exceed 100 C!!!

JUMPERS

The controller allows you to select several things, namely the motor direction, automatic current reduction (reduces current for the holding torque). See the manual on how to perform these changes. Currently the Z and Rotational Axes are implementing automatic current reduction to minimize heating of the motors while not in use. Also I had to change the motor direction on one of the axes to get the proper movement.

MOTOR WIRING

Since the X and Y motors don't require a lot of power, they are wired in half-coil mode (pins 1and6, 4and9 each span half a coil), but the Z and Rotational Axes are wired in 4-lead full coil mode (1and6 span a full coil and 4and9 span another full coil). The full coil mode give greater torque, but tends to heat the motors.

CONNECTING NEAT TO COMPUTER

In order to connect the NEAT to the computer one needs a Universal Motion Interface (See UMI). The 25 pin connector connects the NEAT to the UMI. The connections that need to be made are the following.

4. GND
6. Z-Dir (Axis3)
7. Y-Dir (Axis2)
8. X-Dir (Axis1)
10. U-Dir (or the Rotational)(Axis4)
16. +5V
18. Z-Step
19. Y-Step
20. X-Step
22. U-Step (or the Rotational)

These are wired into the corresponding locations in the UMI using a 25 pin connector and a ribbon cable.

THE UMI (and Limit Switches and Encoders)

The Universal Motion Interface acts as the interpreter for the National Instruments motion card. The UMI takes signals from the computer and sends them to the NEAT driver. It also accepts encoder and limit inputs for each axis.

Axes X,Y and Z have limit switches, and corresponding connectors have been made to connect to the limit switches using three 8-pin CPC's and Gray Cables. To wire the limit switches in the UMI one simply wires the Normally Open lead of the limit switch to the corresponding Limit Switch lead in the UMI, and the Common lead of the limit switch to the Ground in the UMI. The National Instruments card then senses if the switch is open or closed and the computer can then tell if the switch is open or closed simply without the switches requiring any power.

Axes Z and Rotation have encoders. The six output encoder is wired into axes 3 and 4 of the UMI using CPC's and black cables straight across (i.e. A to A, B to B, A'toA', Index to Index etc). The encoders only function if the NEAT controller is powered.

The gender of the Gray (limit) cables and the Black (Encoder) cables is the opposite to avoid improper wiring mistakes.

The UMI is connected to the card using a 2m National Instruments Cable. The cable is plugged into the slot on the NI motion card that controls axes 1-4 (See the manual for the card if you have questions about that).

Appendix A
“.ini” files

In this appendix appropriate text is given to create the necessary .ini files. To do so copy and paste the red text into a text-editor (I use Notepad) and save as “filename.ini” These .ini files should then be moved to the “ini” folder of the current SES software.

```
***********************************************
CurrentPosition.ini
***********************************************
[Initial Positions]
X-Axis=0.0
Y-Axis=0.0
Z-Axis=-238.84
RotationZ=0.0
***********************************************
```

```
***********************************************
CalibDefVelLimit.ini
***********************************************
[Manipulator Limits]
XYRangeAnalyzer=15.0
XYRangePrep=16.0
Zmin=-475.0
ZValve=-183.0
ZShutter=-63.0
Zmax=-5.0
PosRotUpper=270.0
NegRotUpper=-40.0
PosRotLower=110.0
NegRotLower=-40.0
PosTransferRot=3.0
NegTransferRot=-3.0
[Default Speed]
X Velocity=0.5
Y Velocity=0.5
Z Velocity=3.7
RZ Velocity=3
[Calibration Steps/Unit]
X Steps/mm=1569.0
Y Steps/mm=1569.0
```

```
Z Steps/mm=7874.0157
RZ Steps/deg=1000.0
************************************************
```

```
************************************************
Manipulator.ini
************************************************
[Manipulator]
Continue On Error=0
Movement Dialogue Treshold=0
Close Dialogue after Movement=0
Manipulator HW Library=dll\ManiHWMineAndNIFlexMotionV5.dll
[Run Mode Regions]
Number of Regions=4
[Positions]
Number of Positions=10
[Setup Manipulator]
Left=338
Top=295
[Manipulator Movement]
Left=778
Top=442
[HW Dummy]
Axis Count=4
Axis 1 Name=X-Axis
Axis 1 Units=mm
Axis 1 Rotation=0
Axis 1 Use Limits=0
Axis 1 Lower Limit=-10
Axis 1 Upper Limit=10
Axis 2 Name=Y-Axis
Axis 2 Units=mm
Axis 2 Rotation=0
Axis 2 Use Limits=0
Axis 2 Lower Limit=-10
Axis 2 Upper Limit=10
Axis 3 Name=Z-Axis
Axis 3 Units=mm
Axis 3 Rotation=0
Axis 3 Use Limits=0
Axis 3 Lower Limit=-100
Axis 3 Upper Limit=100
Axis 4 Name=RotationZ
Axis 4 Units=deg
Axis 4 Rotation=0
Axis 4 Use Limits=0
Axis 4 Lower Limit=0
Axis 4 Upper Limit=0
Has Speed=0
[Control Manipulator]
Left=2
Top=368
Position Step Size=0.1
Speed Step Size=0.1
Move Immediately=0
[Edit Positions]
Left=337
Top=212
[Regions]
Number of Regions=2
[Region 1]
ID=0
Axis 1 Position=3
Axis 2 Position=4
Axis 3 Position=4
Axis 4 Position=0
Axis 5 Position=0
Axis 6 Position=0
[Region Editor]
Left=0
Top=0
[Region 2]
ID=1
Axis 1 Position=0
Axis 2 Position=0
Axis 3 Position=0
Axis 4 Position=0
Axis 5 Position=0
Axis 6 Position=0
[Run Mode Region 1]
ID=0
Steps=17
Calculated Scale=1
Continuous Scan=0
Repeat Continuous=0
Scan Time=1000
Axis 1 Type=1
Axis 1 Positions=1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
Axis 2 Type=1
Axis 2 Positions=-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5
Axis 3 Type=1
Axis 3 Positions=-418,-417.75,-417.5,-417.25,-417,-416.75,-416.5,-416.25,-416,-415.75,-415.5,-415.25,-415,-414.75,-414.5,-414.25,-414
Axis 4 Type=1
Axis 4 Positions=9.8,9.8,9.8,9.8,9.8,9.8,9.8,9.8,9.8,9.8,9.8,9.8,9.8,9.8,9.8,9.8,9.8
Scale=1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17
Axis 5 Type=1
Axis 5 Positions=0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
Axis 6 Type=1
Axis 6 Positions=0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
[Run Mode Editor]
Left=398
Top=149
[Position 1]
Name=Sample 5 LEED
Axis 1=0
Axis 2=0
Axis 3=-10
Axis 4=90
Axis 5=0
Axis 6=0
[Position 2]
Name=Sample 4 LEED
Axis 1=0
Axis 2=0
Axis 3=-22.7
Axis 4=90
Axis 5=0
Axis 6=0
[Position 3]
Name=Sample 3 LEED
Axis 1=0
Axis 2=0
Axis 3=-35.4
Axis 4=90
Axis 5=0
Axis 6=0
[Position 4]
Name=Sample 2 LEED
Axis 1=0
Axis 2=0
Axis 3=-48.1
Axis 4=90
Axis 5=0
Axis 6=0
[Position 5]
Name=Sample 1 LEED
Axis 1=0
Axis 2=0
Axis 3=-60.8
Axis 4=90
Axis 5=0
Axis 6=0
[Position 6]
Name=Sample 5 Evaporator
Axis 1=0
Axis 2=0
Axis 3=-10
Axis 4=180
Axis 5=0
Axis 6=0
[Position 7]
Name=Sample 4 Evaporator
Axis 1=0
Axis 2=0
Axis 3=-22.7
Axis 4=180
Axis 5=0
Axis 6=0
[Position 8]
Name=Sample 3 Evaporator
Axis 1=0
Axis 2=0
Axis 3=-35.4
Axis 4=180
Axis 5=0
Axis 6=0
[Position 9]
Name=Sample 2 Evaporator
Axis 1=0
Axis 2=0
Axis 3=-48.1
Axis 4=180
Axis 5=0
Axis 6=0
[Position 10]
Name=Sample 1 Evaporator
Axis 1=0
Axis 2=0
Axis 3=-60.8
Axis 4=180
Axis 5=0
Axis 6=0
[Run Mode Region 2]
ID=1
Steps=49
Calculated Scale=1
Continuous Scan=0
Repeat Continuous=0
Scan Time=1000
Axis 1 Type=1
Axis 1 Positions=-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-
0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-
0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-
0.95,-0.95,-0.95,-0.95,-0.95,-0.95,-0.95
Axis 2 Type=1
Axis 2
Positions=0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0
Axis 3 Type=1
Axis 3 Positions=-441.744,-441.744,-441.744,-441.744,-441.744,-441.744,-441.744,-
441.744,-441.744,-441.744,-441.744,-441.744,-441.744,-441.744,-441.744,-441.744,-
441.744,-441.744,-441.744,-441.744,-441.744,-441.744,-441.744,-441.744,-441.744,-
441.744,-441.744,-441.744,-441.744,-441.744,-441.744,-441.744,-441.744,-441.744,-
441.744,-441.744,-441.744,-441.744,-441.744,-441.744,-441.744,-441.744,-441.744,-
441.744,-441.744,-441.744,-441.744,-441.744,-441.744
Axis 4 Type=1
Axis 4 Positions=-9.25,-9,-8.75,-8.5,-8.25,-8,-7.75,-7.5,-7.25,-7,-6.75,-6.5,-6.25,-6,-5.75,-
5.5,-5.25,-5,-4.75,-4.5,-4.25,-4,-3.75,-3.5,-3.25,-3,-2.75,-2.5,-2.25,-2,-1.75,-1.5,-1.25,-1,-
0.75,-0.5,-0.25,0,0.25,0.5,0.75,1,1.25,1.5,1.75,2,2.25,2.5,2.75
Axis 5 Type=1
Axis 5
Positions=0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0
Axis 6 Type=1
Axis 6
Positions=0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,
0,0,0,0,0,0,0
Scale=1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,
31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49
[Run Mode Region 3]
ID=2
Steps=13
Calculated Scale=1
Continuous Scan=0
Repeat Continuous=0
```

```
Scan Time=1000
Axis 1 Type=1
Axis 1 Positions=-0.8,-0.8,-0.8,-0.8,-0.8,-0.8,-0.8,-0.8,-0.8,-0.8,-0.8,-0.8,-0.8
Axis 2 Type=1
Axis 2 Positions=0,0,0,0,0,0,0,0,0,0,0,0,0
Axis 3 Type=1
Axis 3 Positions=-441.744,-441.744,-441.744,-441.744,-441.744,-441.744,-441.744,-
441.744,-441.744,-441.744,-441.744,-441.744,-441.744
Axis 4 Type=1
Axis 4 Positions=-9.25,-8.25,-7.25,-6.25,-5.25,-4.25,-3.25,-2.25,-1.25,-
0.25,0.75,1.75,2.75
Axis 5 Type=1
Axis 5 Positions=0,0,0,0,0,0,0,0,0,0,0,0,0
Axis 6 Type=1
Axis 6 Positions=0,0,0,0,0,0,0,0,0,0,0,0,0
Scale=1,2,3,4,5,6,7,8,9,10,11,12,13
[Run Mode Region 4]
ID=3
Steps=40
Calculated Scale=1
Continuous Scan=0
Repeat Continuous=0
Scan Time=1000
Axis 1 Type=1
Axis 1
Positions=0.85,0.85,0.85,0.85,0.85,0.85,0.85,0.85,0.85,0.85,0.85,0.85,0.85,0.85,0.85,0.85
,0.85,0.85,0.85,0.85,0.85,0.85,0.85,0.85,0.85,0.85,0.85,0.85,0.85,0.85,0.85,0.85,0.85,0.85
,0.85,0.85,0.85,0.85,0.85,0.85
Axis 2 Type=1
Axis 2 Positions=-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-
1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-1.5,-
1.5,-1.5,-1.5,-1.5,-1.5,-1.5
Axis 3 Type=1
Axis 3 Positions=-466.6,-466.6,-466.6,-466.6,-466.6,-466.6,-466.6,-466.6,-466.6,-466.6,-
466.6,-466.6,-466.6,-466.6,-466.6,-466.6,-466.6,-466.6,-466.6,-466.6,-466.6,-466.6,-
466.6,-466.6,-466.6,-466.6,-466.6,-466.6,-466.6,-466.6,-466.6,-466.6,-466.6,-466.6,-
466.6,-466.6,-466.6,-466.6,-466.6,-466.6
Axis 4 Type=1
Axis 4 Positions=-25,-24,-23,-22,-21,-20,-19,-18,-17,-16,-15,-14,-13,-12,-11,-10,-9,-8,-
7,-6,-5,-4,-3,-2,-1,0,1,2,3,4,5,6,7,8,9,10,11,12,13,14
Axis 5 Type=1
Axis 5
Positions=0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
Axis 6 Type=1
Axis 6
Positions=0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
```

```
Scale=1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,
31,32,33,34,35,36,37,38,39,40
************************************************
```

```
************************************************
Monochromator.ini
************************************************
[Monochromator]
Continue On Error=0
Avoid Same Energy=1
Monochromator HW Library=dll\MonoHWMine.dll
[Regions]
Number of Regions=2
[Positions]
Number of Positions=0
[Events]
Number of Events=2
[Event 1]
ID=0
Energy=24
[Event 2]
ID=1
Energy=20
[CurrentBeamline]
Beamline=2
ComPort=1
Resolution=19.9532253031935
EntranceSlit=170
ExitSlit=150
ConstantSlit=1
Energy=48
ManualControl=1
[Monochromator Settings]
MinEnergy=8
MaxEnergy=299
MinEnergyStep=0.02
MaxEnergyStep=299
[Region 1]
Kind=0
ID=0
Start Energy=18
Stop Energy=24
Energy Steps=13
```

```
Display Mode=0
[Region 2]
Kind=0
ID=1
Start Energy=43
Stop Energy=51
Energy Steps=9
Display Mode=0
************************************************
```

Labview VI’s here

Delphi Code Here