MIRAO52-E Micro-Manager device adapter user guide

1. Introduction

This is a compact user guide for the MIRAO52E device adapter for Micro-Manager. This device adapter allows for low level control of the deformable mirror MIRAO52E by Micro-Manager using the SDK provided by Imagine Optic. This device adapter is not a GUI to control the mirror, but the Micro-Manager user interface or script panel can be used to control the mirror.

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2. Installation

- Get Micro-Manager version 1.4.23 (From: https://micro-manager.org/wiki/Micro-Manager_Nightly_Builds)
- Copy the MIRAO folder in Micro-Manager installation folder
- Copy all .dll-files from MIRAO/lib folder to the Micro-Manager installation folder
- Add the MIRAO in a hardware configuration as usual (https://micro-manager.org/wiki/Micro-Manager_Configuration_Guide)
  The MIRAO52E device should appear under IODeformableMirror → add "MIRAO52E | Mirao52-e". No further details are required.
  For testing one can use "MIRAO52E_FAKE | Fake Mirao52-e", which is a fake mirror.

MIRAO can now be used by Micro-Manager.

3. Initialization

MIRAO device adapter requires 5 initialization files upon start up. These files should be located in the *MIRAO/init* folder with the following names:

- "MIRAO/init/MIRAO_initialization.dat"
- "MIRAO/init/Diversity_calibration.xml"
- "MIRAO/init/Diversity_prefs.xml"
- "MIRAO/init/MIRAO_calibration.aomi"

These files are loaded upon initialization by Micro-Manager and can be replaced with an updated calibration/preference file as long as the name stays the same. All files except MIRAO_initialization.dat can also be changed during operation with Micro-Manager.

If a wavefront correction file with the following name

"MIRAO/init/WavefrontCorrection.wcs"

is present in the folder *MIRAO/init* this wavefront is applied by the mirror upon initialization.

The MIRAO_initialization file which is used is for the fake mirror is called "Fake_Mirao52-e_0219.dat".

4. Controlling MIRAO52E with MicroManager

The Micro-Manager core strictly separates its bottom level api (i.e. the interface to devices), and the top level api (the interface to the user interface, scripts, etc..). It is therefore not possible to create functions in a device adapter. As a work around the MIRAO52E device adapter has "properties" with certain functionalities. These "properties" can be called in the scripting environment of Micro-Manger or can be found and changed in the "Device Properties Browser"

The MIRAO device adapter has the following "properties".

- ***"Set calibration path"***

  Functionality
  Loads the mirror calibration file (can be .aomi or .aoc)

  Remarks
  Calling this property will set all Zernike modes to 0.
  If the file specified exists but is not a mirror calibration file MicroManager will crash.

- ***"Set calibration params path"***

  Functionality
  Loads the Diversity calibration file.

  Remarks
  Calling this property will set all Zernike modes to 0.
  If the file specified exists but is not a diversity calibration file MicroManager will crash.

- ***"Set diversity preferences path";***

  Functionality
  Loads a diversity preferences file and applies this wavefront.

  Remarks
  Calling this property will set all Zernike modes to 0.
  If the file specified exists but is not a correct diversity preferences file MicroManager will crash.

- ***"Load wavefront";***

  Functionality
  Loads a wavefront file created by ***"Save current position [input filename]"*** and applies this wavefront. All Zernike modes are set to 0.

  Remarks
  Clicking on this property in the Device Properties Browser will run this function and set all Zernike modes to 0.
  If the file specified exists but is not a correct wavefront file MicroManager will crash.

- ***"Save current position [input filename]"***

  Functionality
  Saves the current position of the mirror the file name given by the user. User should add .wfc for consistency.

  Remarks
  clicking on this property in the Device Properties Browser will run this function and will override a previous file with the same name.

- **"ApplyZernikes"**

  Functionality
  Calling this property applies all Zernike modes with the amplitudes specified by the properties **"Znm"** on top of the loaded wavefront.

  Remarks
  MicroManage waits 10 ms after updating the wavefront.
  MicroManager requires this property to have a value but it not used.

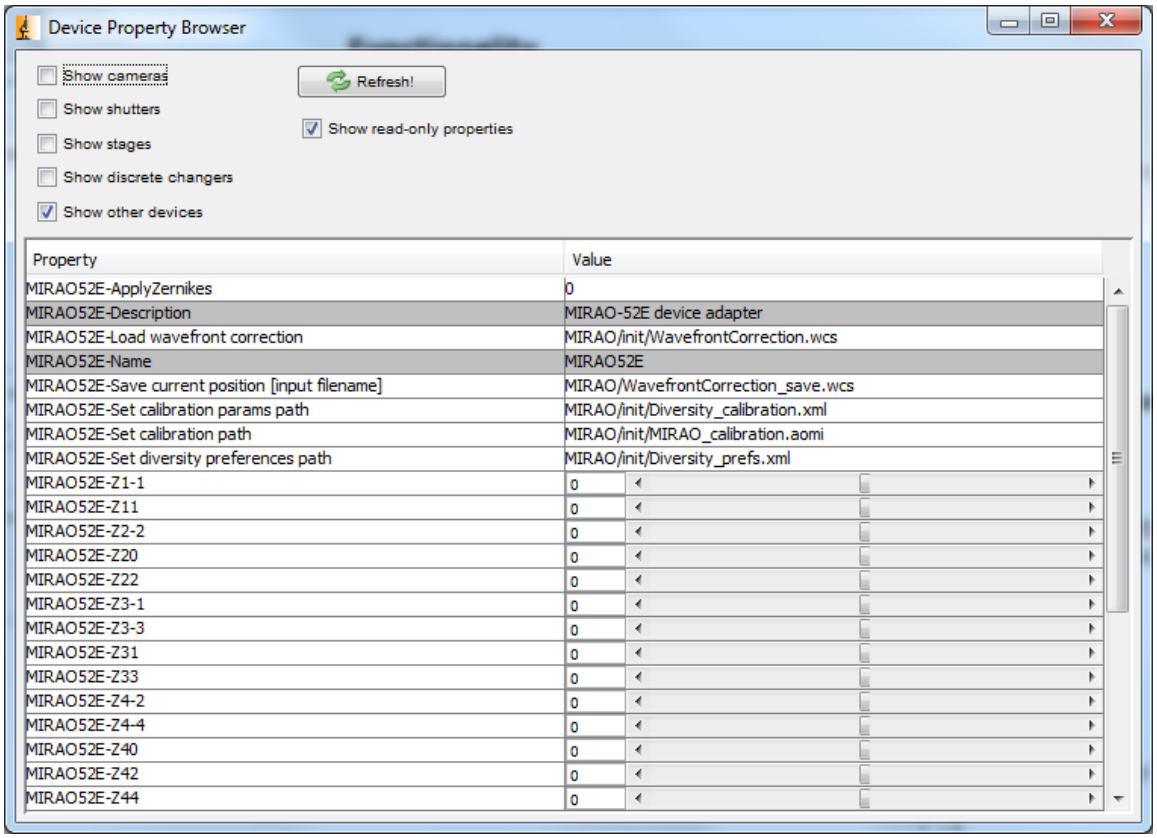
- **"Znm"**

  Functionality
  This property is the amplitude of the Zernike mode Znm (with *n* the radial and *m* the azimuthal order) in um and can range from [-1 1].
  To apply a Zernike mode to the mirror, set the property to the desired value and call property **"ApplyZernikes"**.

  Remarks
  These Zernike mode amplitudes are the amplitudes relative to the loaded wavefront.

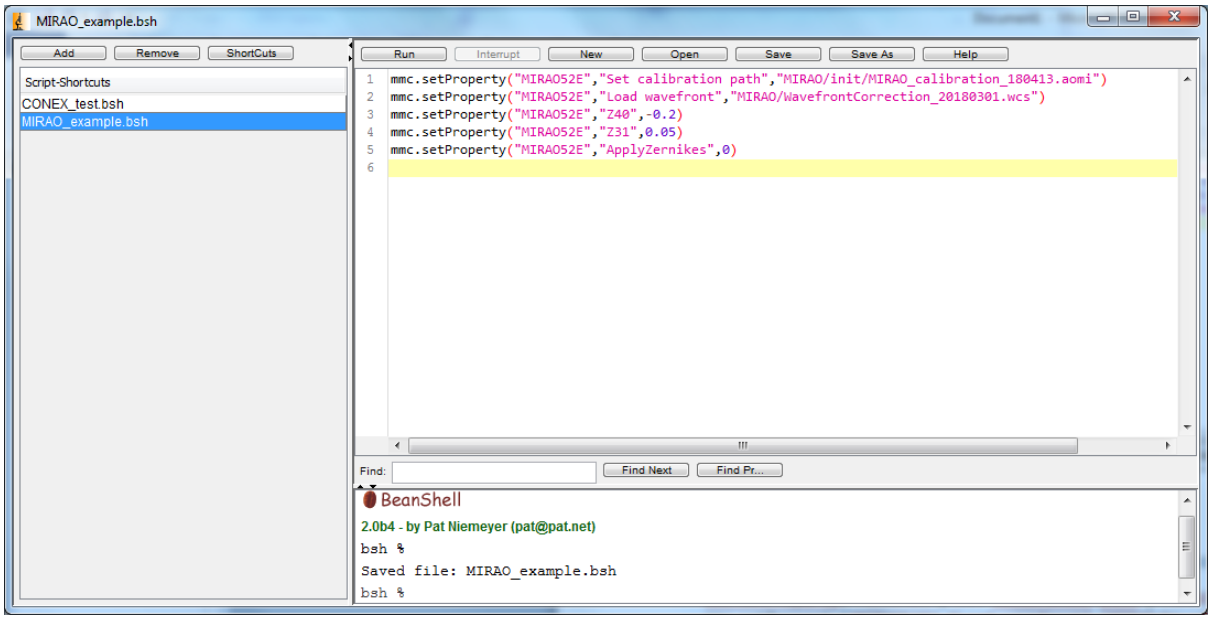
4.1 Manual control

The Zernike modes can be manually set using the "Device Properties Browser" (Tools> Device Properties Browser). To apply a certain Zernike mode use the slider or type in a number. Next, click on "ApplyZernikes" and press enter or click somewhere else.



4.2 Using the Script panel

The script panel can be found by Tools>Script Panel. The properties of the MIRAO device can be changed or called with the command *mmc.set("MIRAO52E","Property","input")*. Here the input can be a calibration file, wavefront file, Zernie mode amplitude, etc. The example script below loads a calibration file, applies a wavefront file and applies Zernike modes Z40 and Z31 with amplitudes -0.2 and 0.05 um.




```
mmc.setProperty("MIRAO52E","Set calibration path","MIRAO/init/MIRAO_calibration_180413.aomi")
mmc.setProperty("MIRAO52E","Load wavefront","MIRAO/WavefrontCorrection_20180301.wcs")
mmc.setProperty("MIRAO52E","Z40",-0.2)
mmc.setProperty("MIRAO52E","Z31",0.05)
mmc.setProperty("MIRAO52E","ApplyZernikes",0)
```

5. General remarks

In order the use the mirror again after Micro-Manager is closed the mirror should be switched off and on again.

A user interface (GUI) or plug in could be easily build in JavaScript (https://micro-manager.org/wiki/Writing_plugins_for_Micro-Manager). This plug in would use the commands as in the Script panel to control the mirror.