Preliminary Work on a Standard for Controlling Microscopes


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Contents

- Scope of presentation
- Why a standard is desirable
- Is a “simple” standard possible?
- One implementation
- Putting together a system from different vendors based on a standard
- Who and how will benefit from a standard
Automation in Optical Microscopy

*Controllable devices:*
- Stage (rectangular, rotational)
- Shutters
- Focus (autofocus)
- Light path control
- Objective changer
- Environment
- Condenser
- Micromanipulator
- Diaphragms
- Microtome
- Light sources
- Transmission filters
- Excitation filters
- Emission filters
- Reflection turret (filter cubes)
Parts of the Solution

Solving a user's problem in automated microscopy involves several hardware and software components, which usually come from different vendors:

- Microscopes
- Motorized components and motor controllers
- Cameras
- Image digitizers
- Computers and standard peripherals
- Image processing and analysis
- Image printing
- Statistical data processing
- Other "standard" desktop applications
Imaging Packages and Microscope Automation

Supports two or more automation platforms, one, none.

QWin (LEICA)
Photoshop (Adobe)
Imaging plugins for Photoshop (J.Russ)
Global Lab (Data Translation)
V++ (Digital Optics)
HazeBuster (VayTek)
LUCIA (Laboratory Imaging)

WIT Logical Vision

ImagePro (Media Cybernetics)

IPLab (Scanalytics)

HLImage (Western Vision)

Bioquant (R&M Biometrics)
IDL (Research Systems)

MatLab (MathWorks)
SigmaScan Pro (SPSS)

Scion Image (Scion)
Vision-XXL (Impulse Imaging)

MetaMorph (Universal Imaging)

Clemex Vision (Clemex)

analySIS (Soft Imaging)

Matrox Imaging Library (Matrox)

Imaging VIs (National Instruments)
# Complexity of Microscope Control

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Supported devices</th>
<th>Number of commands</th>
<th>Manual</th>
<th>Program organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leica DMRXA</td>
<td>Stage, focus, lamp, objective changer, reflector turret, light path, diaphragms, DIC turret</td>
<td>228</td>
<td>117 pages</td>
<td>DLLs, ActiveX</td>
</tr>
<tr>
<td>Zeiss AxioPlan</td>
<td>Focus, lamp, objective changer, reflector turret, light path, diaphragms, shutters, condenser, optovar zoom, filter turrets</td>
<td>87</td>
<td>90 pages</td>
<td>ASCII strings</td>
</tr>
<tr>
<td>Nikon Eclipse E1000</td>
<td>Focus, lamp, objective changer, reflector cassette, light path, diaphragms, shutters, condenser</td>
<td>60</td>
<td>25 pages</td>
<td>ASCII strings</td>
</tr>
<tr>
<td>Olympus AX</td>
<td>Focus, lamp, objective changer, reflector turret, light path, diaphragms, shutters, ND/color filters</td>
<td>23</td>
<td>56 pages</td>
<td>ASCII strings</td>
</tr>
<tr>
<td>LUDL MAC 2000</td>
<td>Stage, focus, filter wheels, shutters,</td>
<td>1 cmd for FW and shutters, 16 cmds per linear axis</td>
<td>60 pages</td>
<td>ASCII strings</td>
</tr>
</tbody>
</table>
Interfaces

Application
(e.g., image processing package)

Old (current) style

Microscope manufacturers
Zeiss  Leica  Olympus  Nikon  …

Add-on manufacturers
Martzhauser  LUDL  Prior  ASI  Sutter  CRI  …

New style

Microscope Automation Standard

Implementations of the standard
Commands for Device Control

XY
- Rel <dx> <dy>
- Abs <posx> <posy>
- Home
- Origin
- Pos
- Move <spdx> <spdy>
- Stop
- Wait

Z
- Rel <dz>
- Abs <posz>
- Home
- Origin
- Pos
- Move <spdz>
- Stop
- Wait

F
- Home
- <filt>
- Pos
- Wait
- Next
- Prev
- Num?

MAG <objective>
Distribution of complexity

Traditional approach

Suggested approach
One Implementation

ScopeTool™ - microscope automation server (ActiveX)

res_string = ScopeToolCmd("XY Abs 10000 5000")

Application

User

User Details

- "XYCONTRX", x
- "XYSCREWWLEAD", 1.0
- "XYSTPDEVIDE", 4
- "XYRUNCURRENT", 15
- "XYINICTVALUE", 400
- "XYDECELERATION", 10
- "XYJOGSPEEDHIGH", 200
- "XYBACKLASH", 4
- "XYMOVEOUT", 6000
- "XYHOMESPEED", -10000
- "XYJUMPSIZE", 10

Standard

Hardware

ScopeTool

TM - microscope automation server (ActiveX)

Software

Application

"XCONTRX", x
"XYSCREWWLEAD", 1.0
"XYSTPDEVIDE", 4
"XYRUNCURRENT", 15
"XYINICTVALUE", 400
"XYDECELERATION", 10
"XYJOGSPEEDHIGH", 200
"XYBACKLASH", 4
"XYMOVEOUT", 6000
"XYHOMESPEED", -10000
"XYJUMPSIZE", 10
Desired Configuration

Controlled devices

- XY Stage
- Focus
- Condenser
- Objective changer

Controller

- Excitation filter wheel
- Transmission filter wheel
- Emission filter wheel
- Shutter
Availability

- Microscope, Focus, Condenser, Objective changer
- XY Stage, Transmission filter wheel
- Emission filter wheel, Shutter, Excitation filter wheel
Delivery

Controller

Server supporting devices Z, CDS, MAG

Controller

Server supporting devices XY, F

Controller

Server supporting devices F1, F2, SHT
Setup - Hardware
## Setup - Software

**CONFIG.TXT**

<table>
<thead>
<tr>
<th>Logical device name</th>
<th>Executable name</th>
<th>Class name</th>
<th>Physical device name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Z</td>
<td>Server1</td>
<td>Class1</td>
<td>Z</td>
</tr>
<tr>
<td>CDS</td>
<td>Server1</td>
<td>Class1</td>
<td>CDS</td>
</tr>
<tr>
<td>MAG</td>
<td>Server1</td>
<td>Class1</td>
<td>MAG</td>
</tr>
<tr>
<td>XY</td>
<td>Server2</td>
<td>Class2</td>
<td>XY</td>
</tr>
<tr>
<td>F1</td>
<td>Server2</td>
<td>Class2</td>
<td>F</td>
</tr>
<tr>
<td>F2</td>
<td>Server3</td>
<td>Class3</td>
<td>F1</td>
</tr>
<tr>
<td>F3</td>
<td>Server3</td>
<td>Class3</td>
<td>F2</td>
</tr>
<tr>
<td>SHT</td>
<td>Server3</td>
<td>Class3</td>
<td>SHT</td>
</tr>
</tbody>
</table>

Customer creates the table according to purchased configuration
Execution

Logical device names are translated into physical device names, and commands are sent to appropriate servers
Benefits - 1

_to the end user_

• Get the best solution, not a solution that for historical reasons can work together.
• Get the best price - standards allow competition in components, not systems.
• Get a solution that is not locked into a manufacturer, but can grow in time.
• Procedures and results can be reproduced by a larger audience of peers.
• Easier to commercialize developed procedures and applications.

_to the dealer / distributor_

• Can provide added value to the customer because the components are Windows standard and are fully and easily programmable.
• Can mix and match different equipment to provide the most appropriate solution because all components are software compatible.
• Not locked into representing particular vendors. Their added value can be transferred to other vendors.
Benefits - 2

To the application developer

- Do not have to support all automation means, just one standard.

To the vendor of microscope automation equipment

- By providing the microscope automation server their equipment becomes compatible with all applications (e.g., image processing packages) that need to control it.
Additional capabilities - 1

Scan
- FirstField
- LastField
- NextField
- PreviousField
- GetNumFields
-GetCurrentField

Area Set
- TopLeft
- BotRight
- Top
- Bot
- Left
- Right
Additional capabilities - 2

```
AddCurrent {?<comment>}
Add <x> <y> <z> {?<comment>}
{GetNum | ListClear | ListDraw }
{ListRead | ListWrite} <filename>
{GoTo | Draw} <objnum>
```
Multifilter multiplane image acquisition into ImagePro

Microscope automation server (Runs invisible in this session).

Image acquisition server (Runs invisible in this session).