Automation of SRF cavities optical inspection

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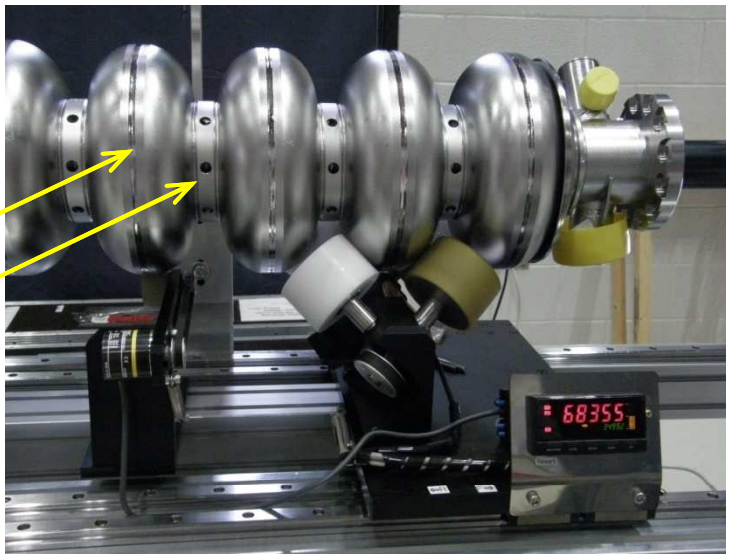
Optical inspection system

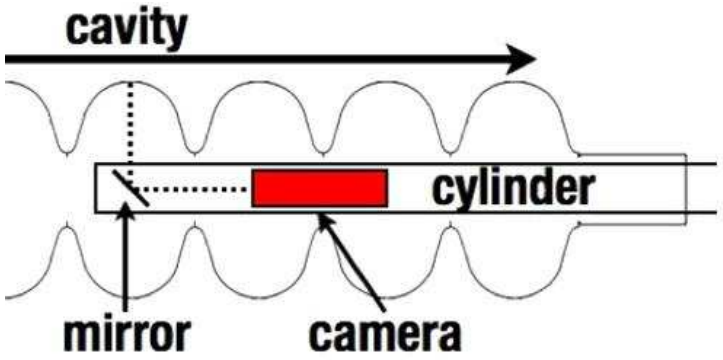
Optical inspection system is designed to study the inner surface of cavities for defects

This includes

- equator welds
- iris welds



Optical camera is used to inspect iris & equator welds



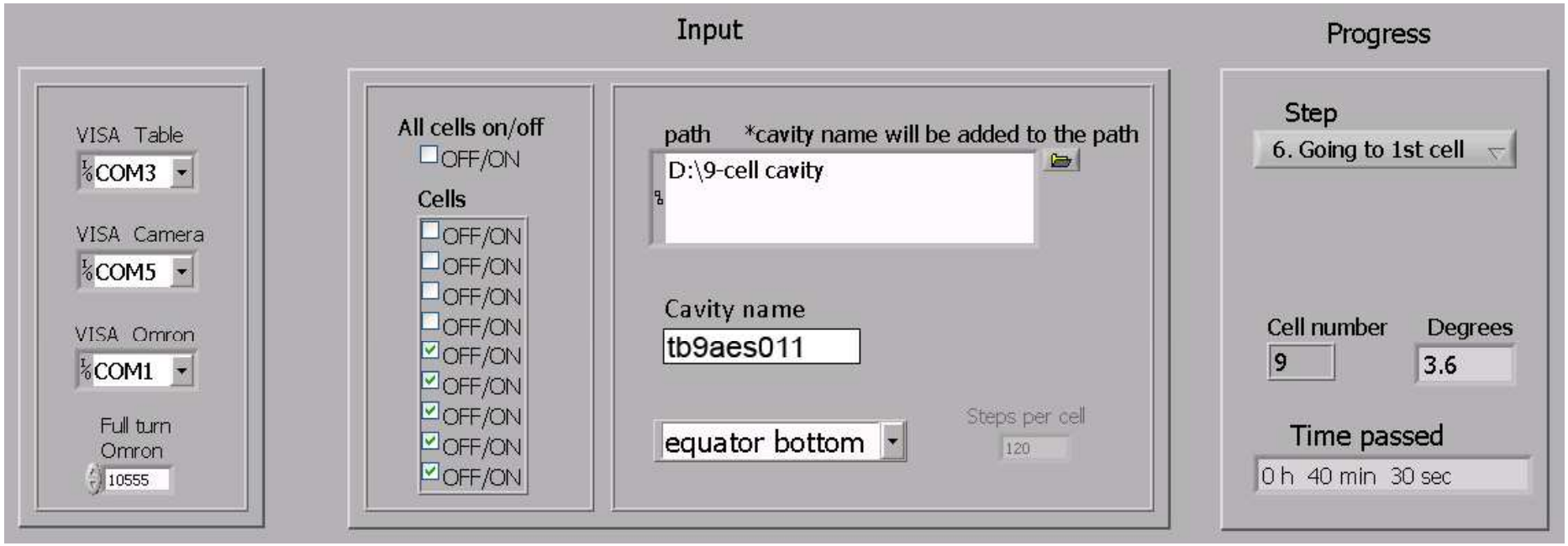
Automation system outline

At present:

- the system performs inspection in **3 hours**
- can work **autonomously**
- still needs some **manual adjustments**

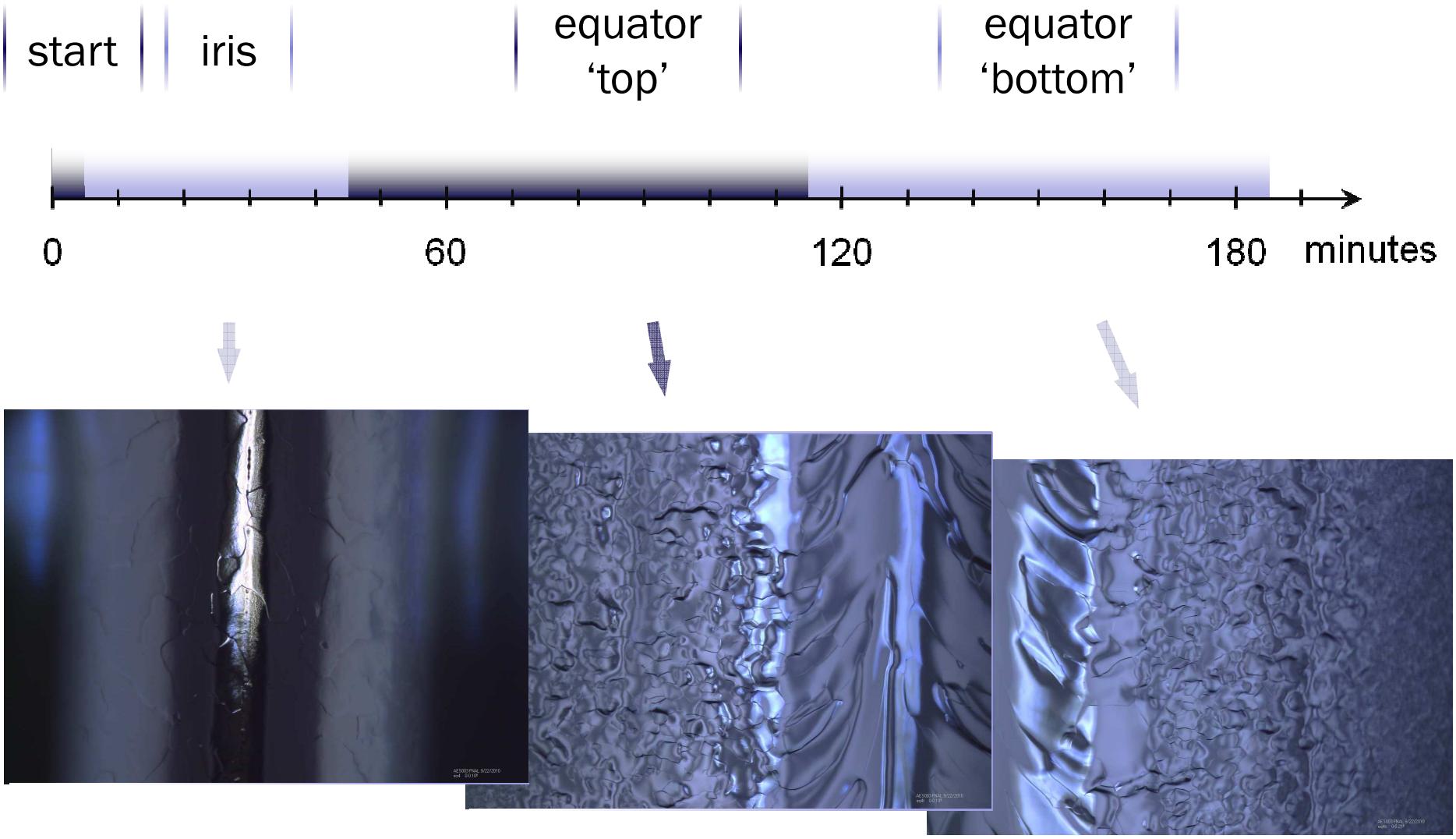
Automation system outline

Main optical inspection program window

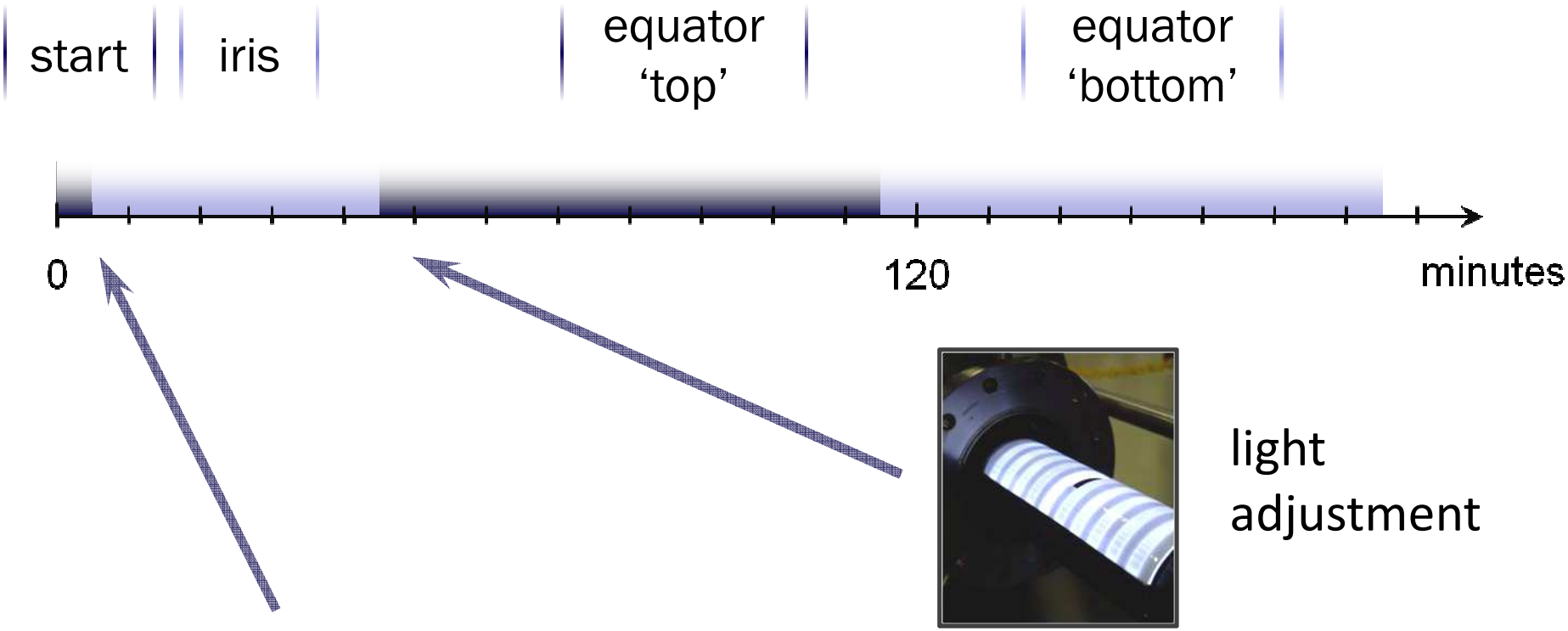


- Initial adjustments for lights, …
- Various error handling
- Basic LabView functions library for further software development

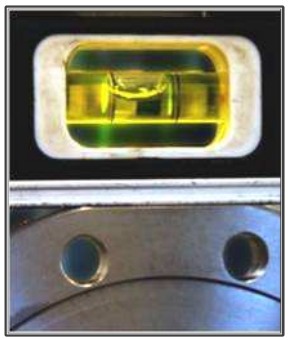
Optical inspection is four-steps:

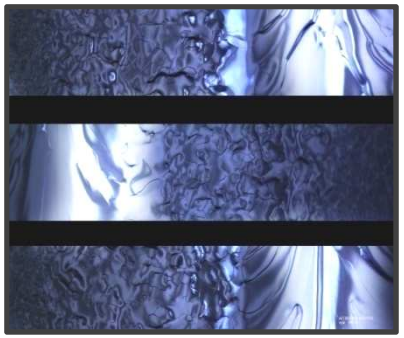


Manual adjustments are necessary



light adjustment





1. horizontal level,
2. wavy equator,
3. light adjustment

Next steps

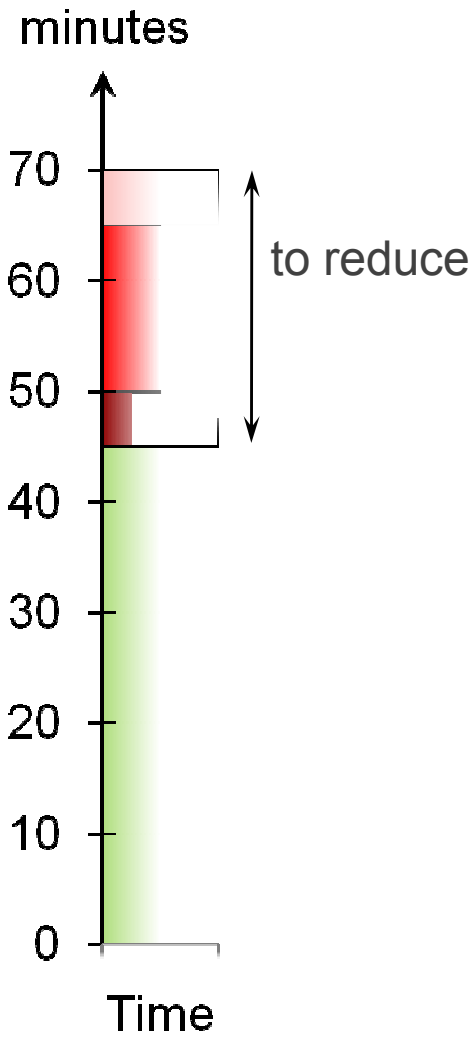
1. Time reduction
   (goal: ~2 hours)

2. Automation of light adjustment

3. Working on quality problems
   (horizontal level shift, …)

4. Images processing

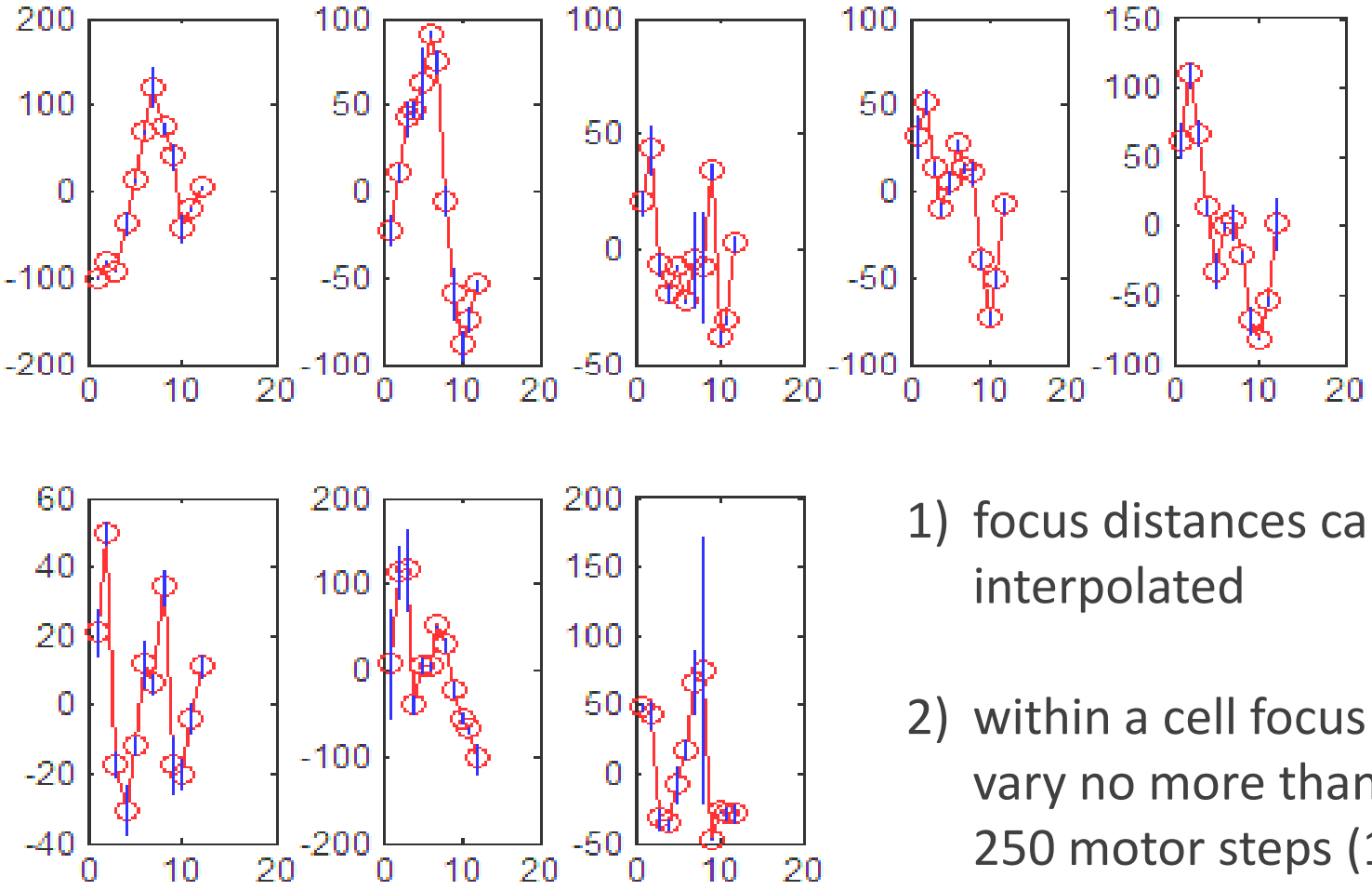
There are options for time reduction



- Number of times to focus
- Autofocus time
- Motor vibration
- Non-reductable

1. Reduction of number of times to focus

Focus distances for 8 irises for angles 0-360:



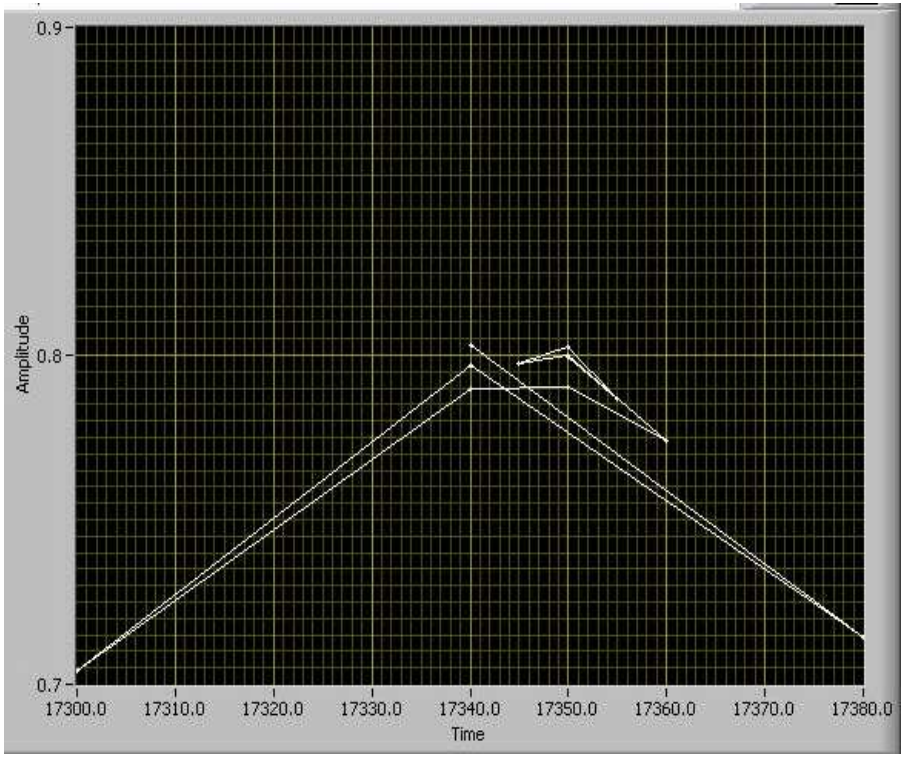
1) focus distances can be interpolated

2) within a cell focus distances vary no more than by 250 motor steps (1 mm) (while 10 steps are noticeable)

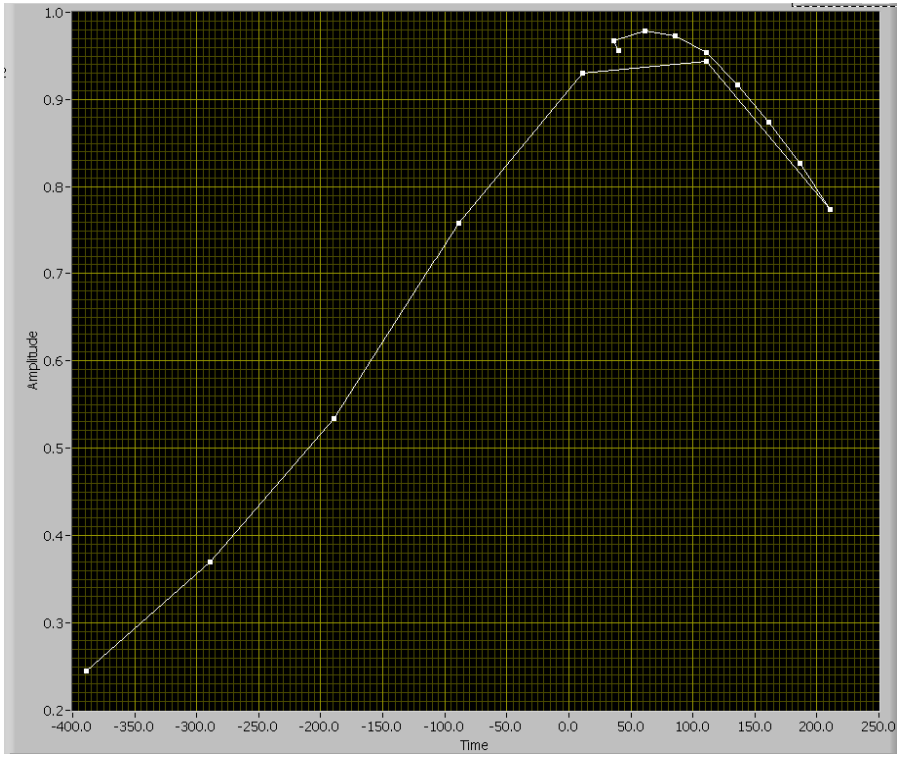
2. Autofocus time reduction

In many cases simple hill-climbing algorithm is too time-consuming because a new focus distance is close to the previous one (left image)

Common hill-climbing case

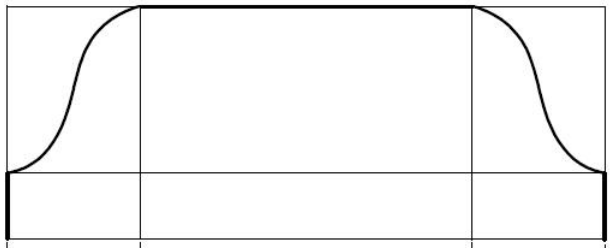


Ideal hill-climbing case

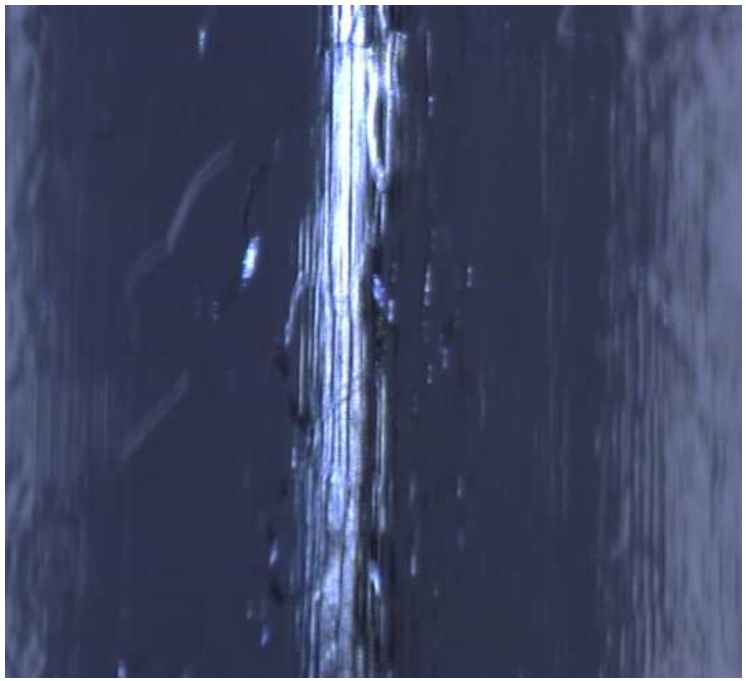


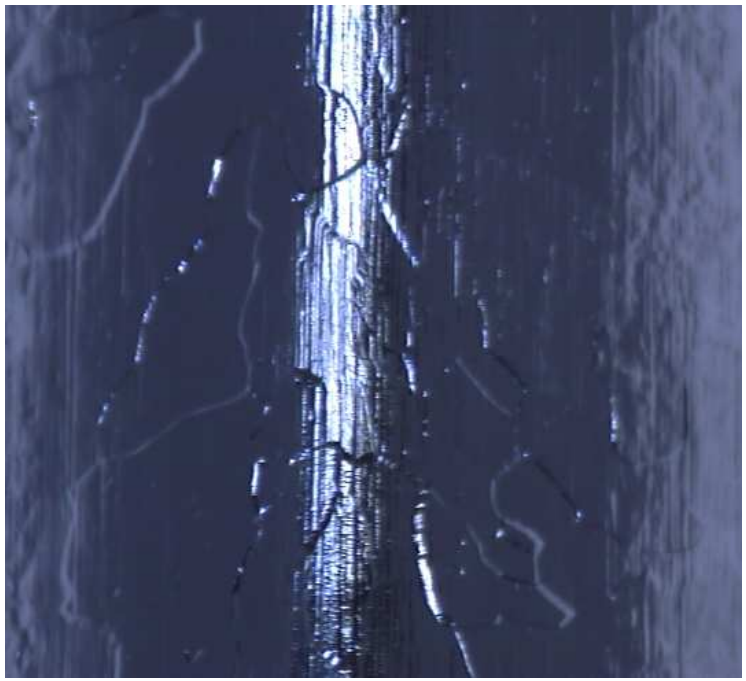
In other cases rough focus adjusting can be made with less steps than at present (right image)

3. Motor vibration effect



Sharp and smooth speed changes result in blurred and clear images respectively



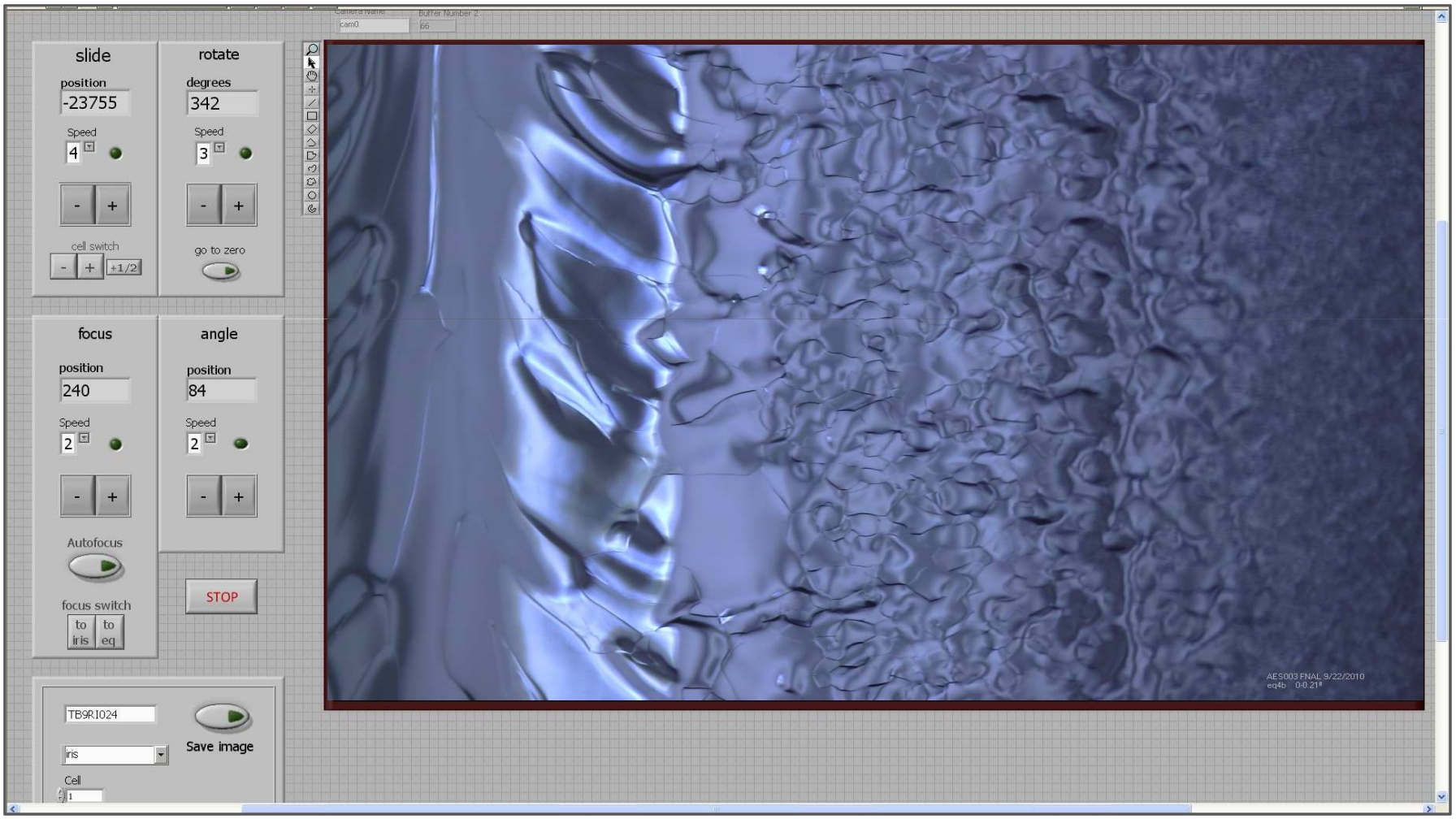


Hence, for the sharp speed function it is necessary to wait 600-1000 ms before taking picture

Q & A

Appendix-1

Control tool - basic



Appendix-2

Control tool - 2