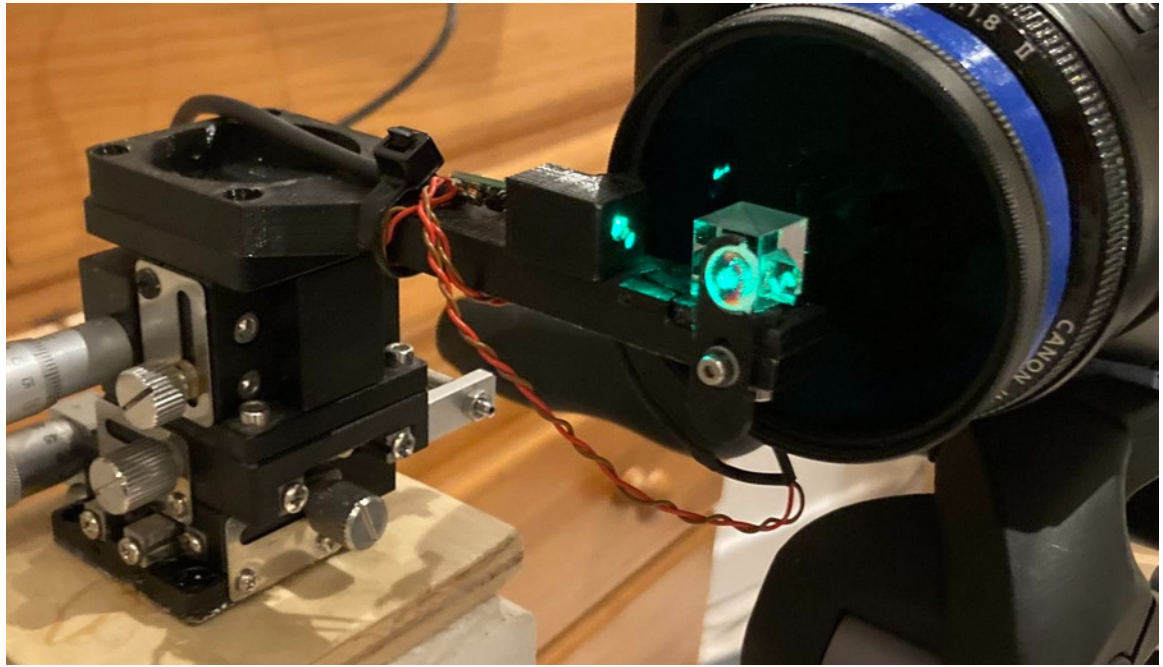
Une interface alternative pour DFTFringe

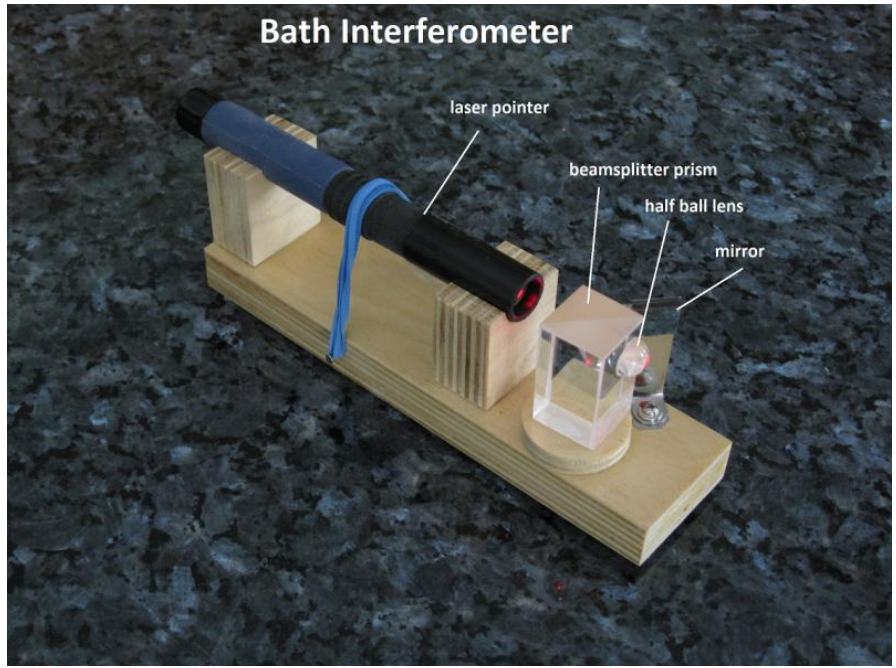
Qu’est-ce que DFTFringe ?

- Un logiciel d’interférométrie libre et open-source
- Souvent utilisé avec un interféromètre de Bath
- Bath + DFTFringe = mesures optiques (de miroirs concaves) absolues pour ~150 euros
- https://github.com/githubdoe/DFTFringe

Crée par Dale Eason à partir d’OpenFringe, maintenu principalement par Dale Eason, George Roberts, Julien Staub

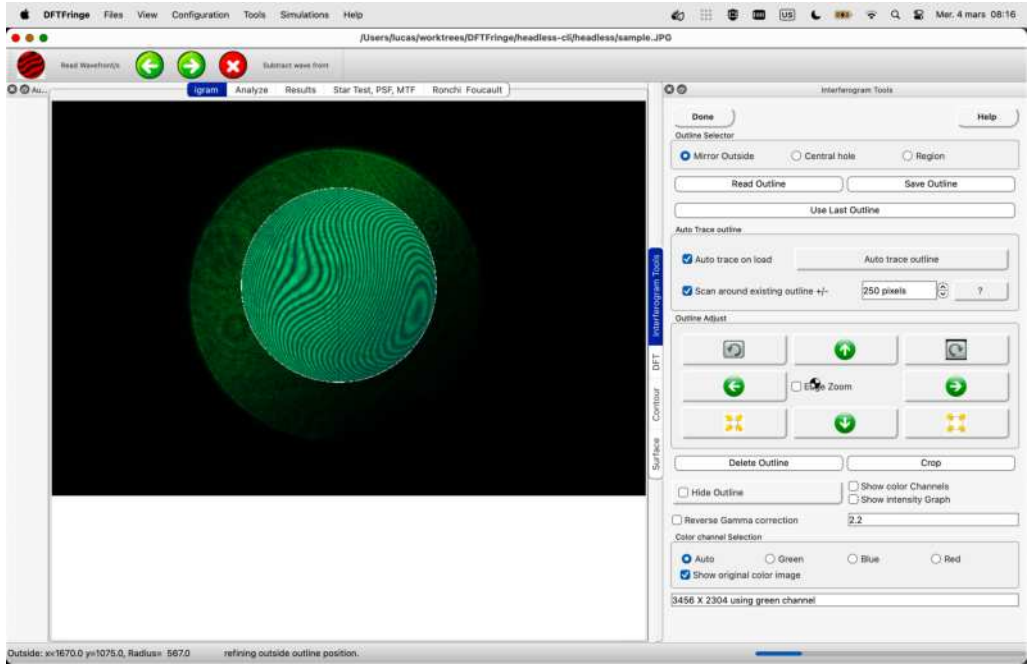

CANON

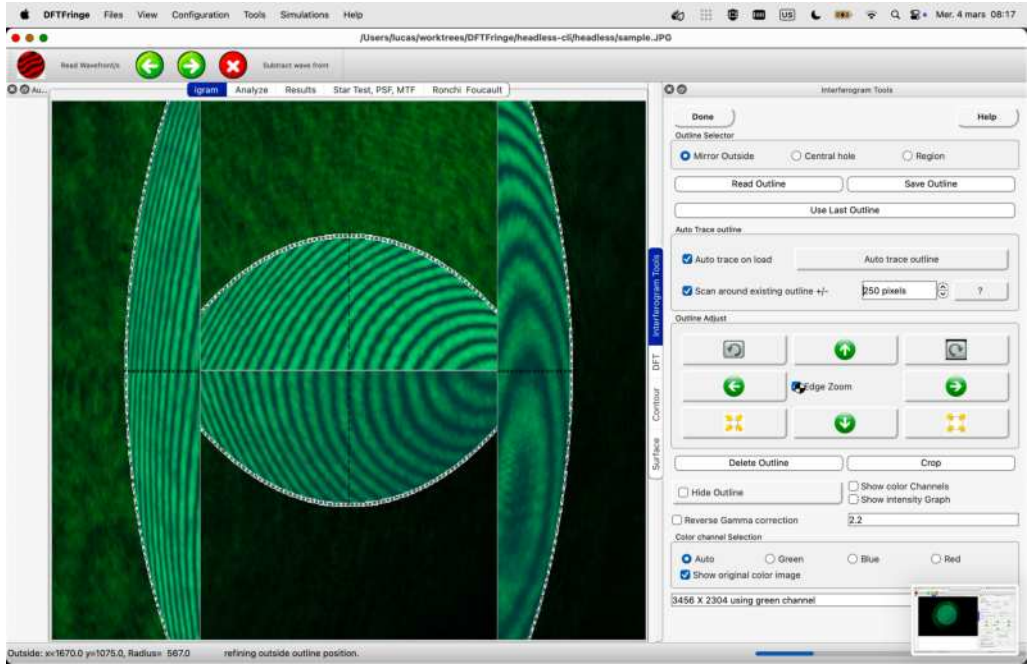
© Ed Jones


Bath Interferometer
laser pointer
beamsplitter prism
half ball lens
mirror

Ressources :

- https://gap47.astrosurf.com/index.php/technique/optique-instruments/controles-optiques/interferometre-de-bath/
- https://www.youtube.com/@bath_interferometers


DFTFringe
Files
View
Configuration
Tools
Simulations
Help
Mer. 4 mars 08:16
/Users/lucas/worktrees/DFTFringe/headless-cli/headless/sample..JPG
Read Wavefront(s)
Subtract wave from
Igram
Analyze
Results
Star Test, PSF, MTF
Ronchi Foucault
Interferogram Tools
Done
Help
Outline Selector
Mirror Outside
Central hole
Region
Read Outline
Save Outline
Use Last Outline
Auto Trace outline
Auto trace on load
Auto trace outline
Scan around existing outline +/-
250 pixels
?
Outline Adjust
Enable Zoom
Delete Outline
Crop
Hide Outline
Show color Channels
Show intensity Graph
Reverse Gamma correction
2.2
Color channel Selection
Auto
Green
Blue
Red
Show original color image
3456 X 2304 using green channel
Interferogram Tools
DFT
Contour
Surface
Outside: x=1670.0 y=1075.0, Radius= 567.0
refining outside outline position.


DFTFringe
Files
View
Configuration
Tools
Simulations
Help
Mer. 4 mars 08:17
/Users/lucas/worktrees/DFTFringe/headless-cli/headless/sample..JPG
Read Wavefront(s)
Subtract wave from
Igram
Analyze
Results
Star Test, PSF, MTF
Ronchi Foucault
Interferogram Tools
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Outline Selector
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Outside: x=1670.0 y=1075.0, Radius= 567.0
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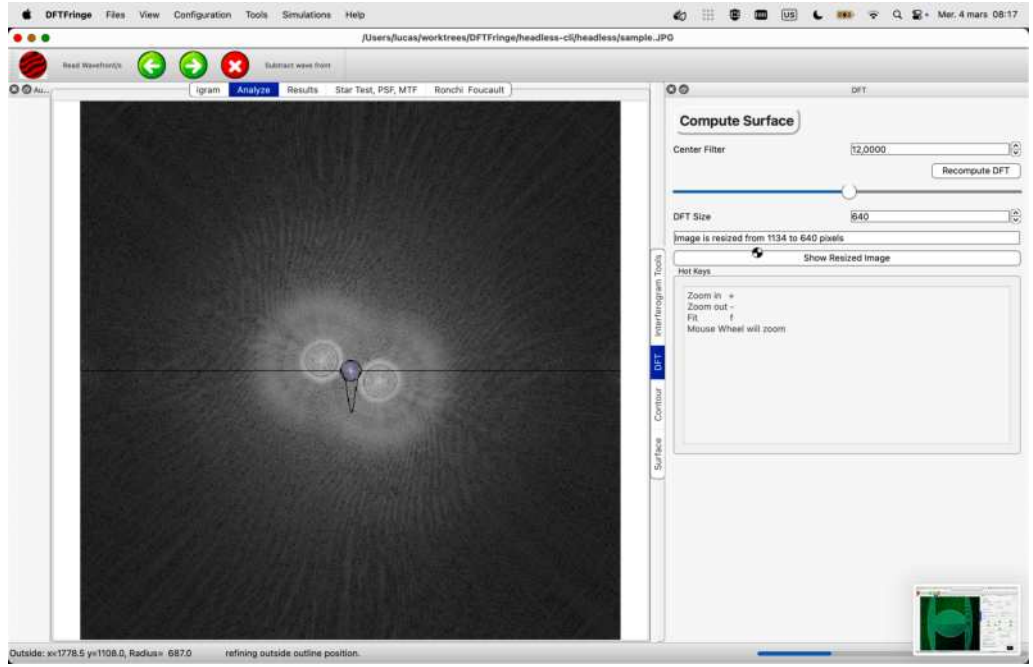
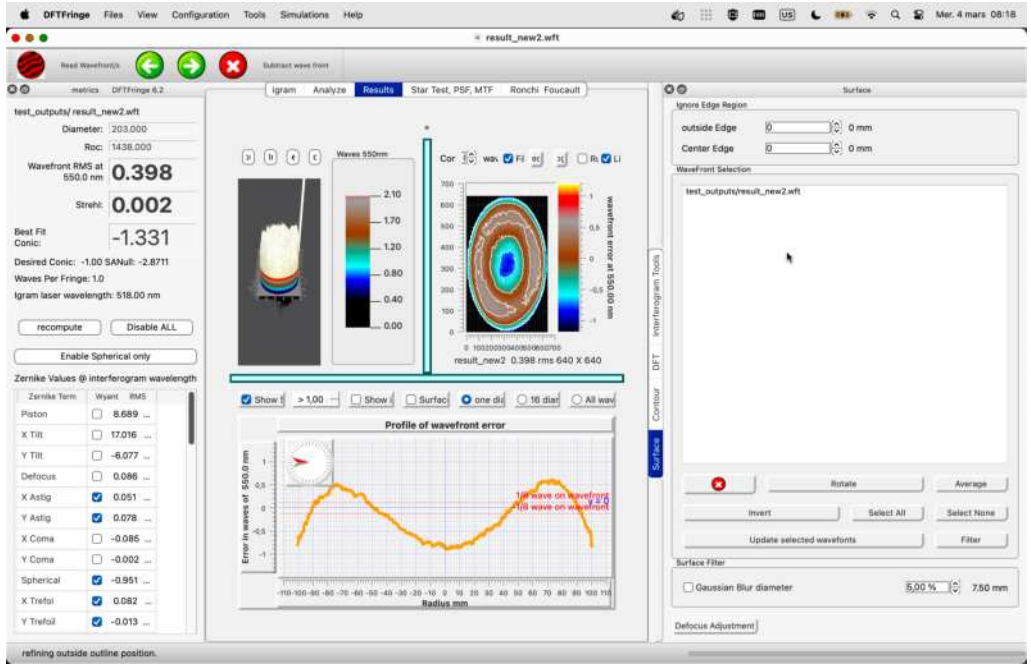
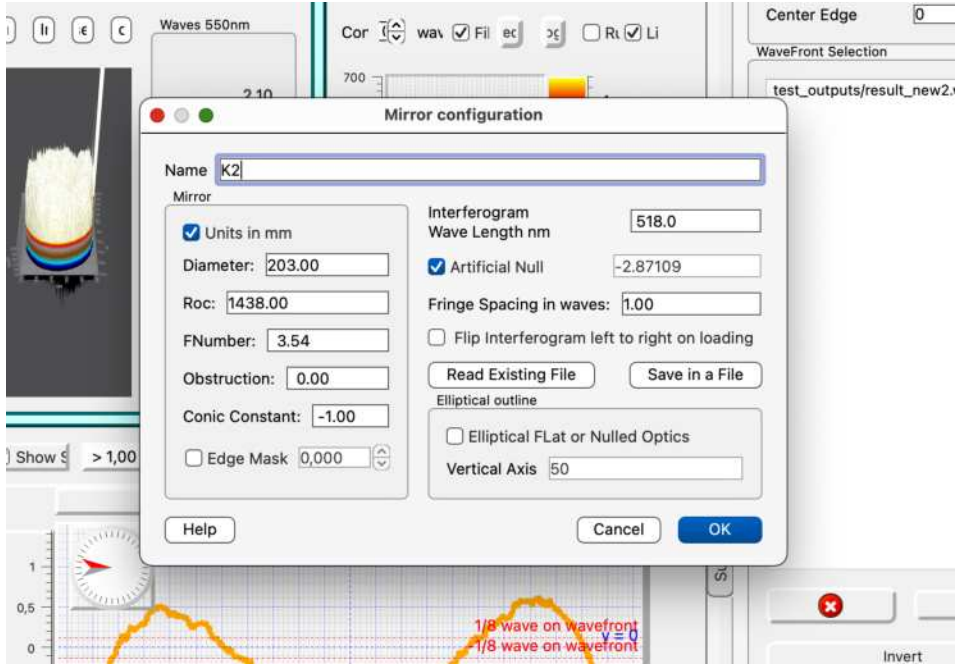

DFTFringe Files View Configuration Tools Simulations Help
Mer. 4 mars 08:17
/Users/lucas/worktrees/DFTFringe/headless-cli/headless/sample..JPG
Read Wavefront(s)
Subtract wave from
igram
Analyze
Results
Star Test, PSF, MTF
Ronchi Foucault
DFT
Compute Surface
Center Filter
12,0000
Recompute DFT
DFT Size
640
Image is resized from 1134 to 640 pixels
Show Resized Image
Hot Keys
Zoom in +
Zoom out -
Fit f
Mouse Wheel will zoom
Interferogram Tools
DFT
Contour
Surface
Outside: x=1778.5 y=1108.0, Radius= 687.0
refining outside outline position.


DFTFringe Files View Configuration Tools Simulations Help
Mer. 4 mars 08:18
result_new2.wft
Read Wavefront/s
Subtract wave from
metrics DFTFringe 6.2
test_outputs/ result_new2.wft
Diameter: 203.000
Roc: 1438.000
Wavefront RMS at 550.0 nm 0.398
Strehl: 0.002
Best Fit Conic: -1.331
Desired Conic: -1.00 SANull: -2.8711
Waves Per Fringe: 1.0
Igram laser wavelength: 518.00 nm
recompute
Disable ALL
Enable Spherical only
Zernike Values @ interferogram wavelength
Zernike Term Wyant RMS
Piston 8.689
X Tilt 17.016
Y Tilt -6.077
Defocus 0.086
X Astig 0.051
Y Astig 0.078
X Coma -0.085
Y Coma -0.002
Spherical -0.951
X Trefoil 0.082
Y Trefoil -0.013
igram Analyze Results Star Test, PSF, MTF Ronchi Foucault
Waves 550nm
2.10
1.70
1.20
0.80
0.40
0.00
result_new2 0.398 rms 640 X 640
Profile of wavefront error
Error in waves of 550.0 nm
Radius mm
1/8 wave on wavefront
-1/8 wave on wavefront
Surface
Ignore Edge Region
outside Edge 0 mm
Center Edge 0 mm
WaveFront Selection
test_outputs/result_new2.wft
Rotate
Average
Invert
Select All
Select None
Update selected wavefonts
Filter
Surface Filter
Gaussian Blur diameter 5,00 % 7.50 mm
Defocus Adjustment
Surface
Contour
DFT
Interferogram Tools
refining outside outline position.


Waves 550nm
Cor
Center Edge
WaveFront Selection
Mirror configuration
Name
K2
Mirror
Units in mm
Diameter:
203.00
Roc:
1438.00
FNumber:
3.54
Obstruction:
0.00
Conic Constant:
-1.00
Edge Mask
0,000
Interferogram
Wave Length nm
518.0
Artificial Null
-2.87109
Fringe Spacing in waves:
1.00
Flip Interferogram left to right on loading
Read Existing File
Save in a File
Elliptical outline
Elliptical FLat or Nulled Optics
Vertical Axis
50
Help
Cancel
OK
1/8 wave on wavefront
-1/8 wave on wavefront
Invert

Les limites de DFTFringe

- Un miroir (ou "un banc optique") à la fois
- D'abord on teste, ensuite on analyse
- Application de bureau QT/C++. Windows / Mac / Linux mais nécessite un environnement graphique.

La proposition

- Fusionner test et analyse

Ma contrainte majeure :

- Pouvoir lancer les algos de DFTFringe sans l'interface graphique

Étape 1 : une CLI DFTFringe

Mon protocole :

- Créer des résultats de référence en utilisant le logiciel graphiquement
- Créer un harnais de tests basés sur ces "golden master"
- Grâce aux tests, tâtonner pour produire un build alternatif 100% ligne de commande
- Étendre ce build pour supporter un mode "sidecar" persistant utilisé via stdI/O

https://github.com/Lucassifoni/DFTFringe/tree/headless-cli/headless

Full processing

```
docker run --rm -v $(pwd):/data dftfringe-cli \
  --input /data/sample.jpg \
  --outline /data/sample.oln \
  --diameter 203 \
  --roc 1438 \
  --lambda 518 \
  --output /data/result.wft \
  --zernikes /data/result.csv \
  --verbose
```

Structured output (--structured-output)

Tab-separated key-value pairs for easy parsing:

```
mode    full
input_file  /path/to/image.jpg
input_width 3456
input_height    2304
outline_center_x    1672.5
outline_center_y    1075
outline_radius  568
mirror_diameter 203
mirror_roc  1438
mirror_lambda   518
mirror_conic    -1.33
...
inversion_detected  false
inversion_applied   false
zernike_raw_0   9.689
zernike_raw_1   17.817
...
zernike_nulled_0    9.689
zernike_nulled_8    -0.003
...
rms_waves   0.058
pv_waves    0.36
strehl  0.87
```

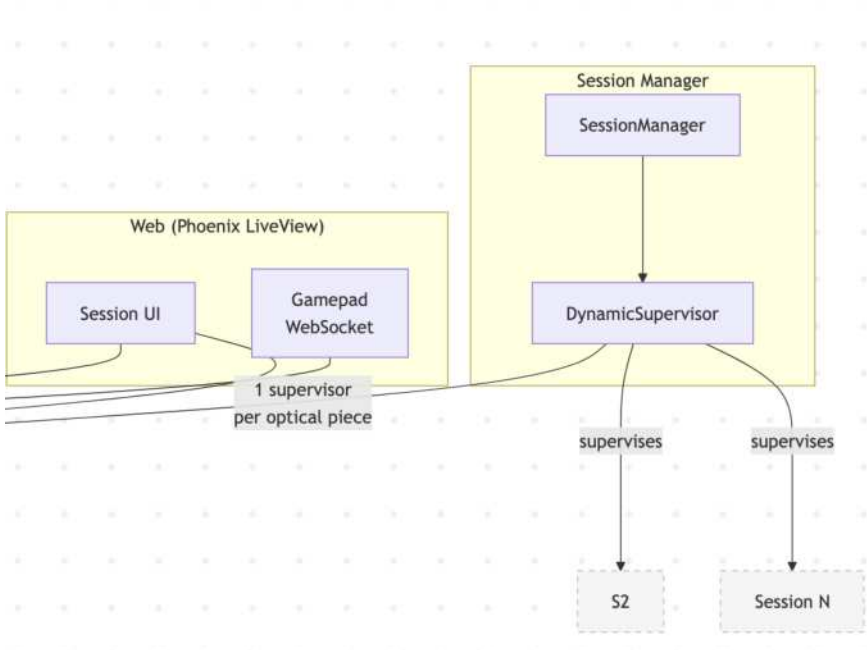
Étape 2 : une interface alternative

Objectifs :

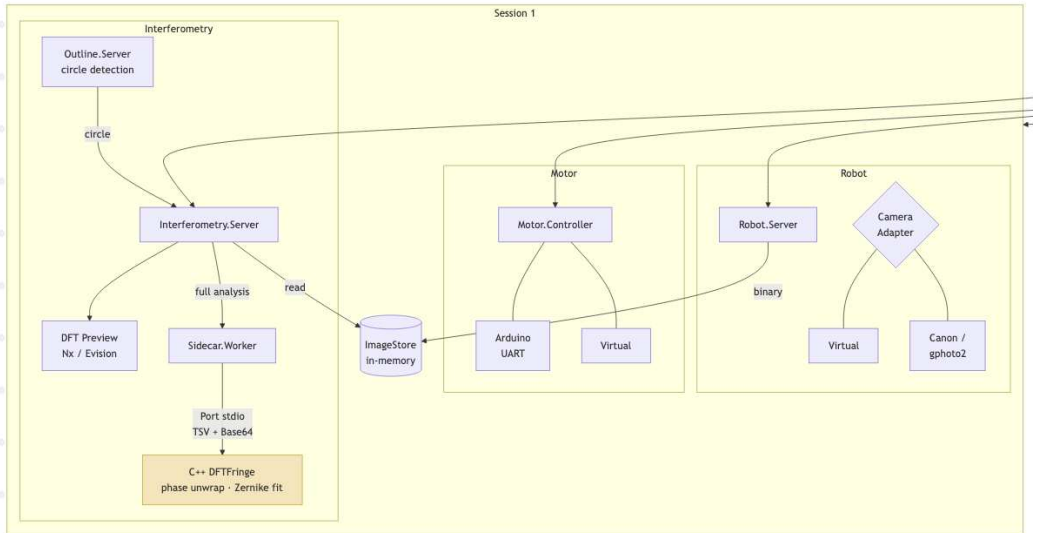
- Plusieurs bancs optiques (= plusieurs config dftfringe)
- 1 config = 1 appareil photo contrôlé par gphoto2
- 1 config = 1 table XYZ motorisée
- Auto-outline sur flux vidéo
- Contrôle par manette de jeu (bouger les axes, ajuster outline, ajuster center filter)

https://github.com/Lucassifoni/rougail-solstice

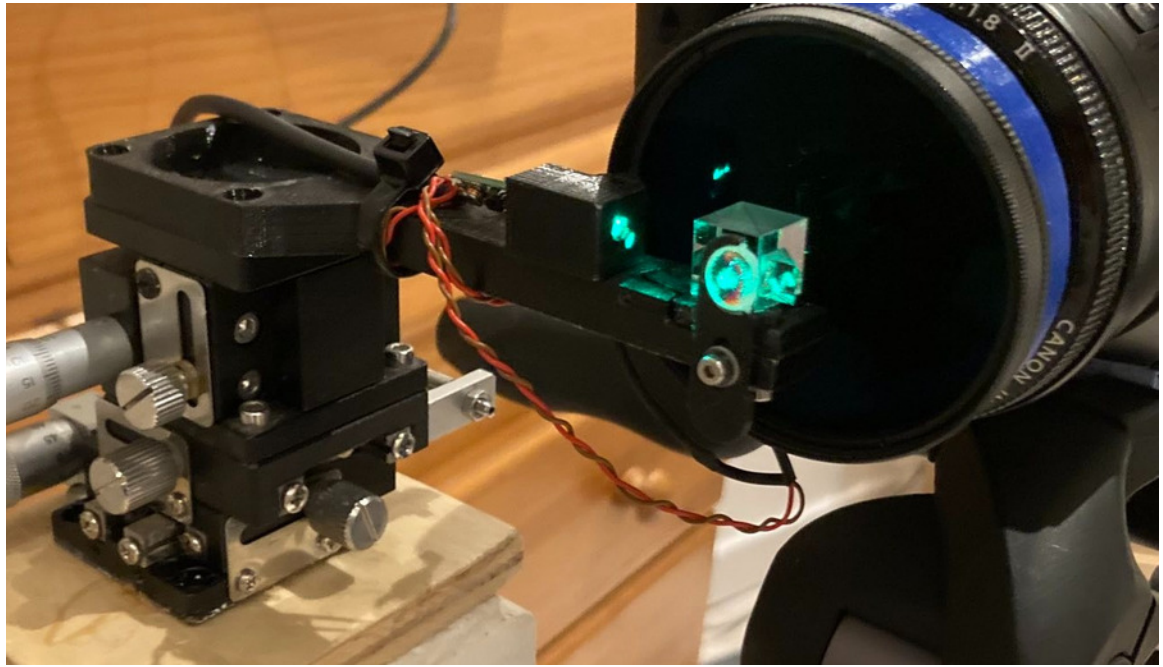
Plusieurs sessions coexistent



Des tâtonnements restent à éliminer - mais chaque session exécute le flux complet d’analyse de manière indépendante



Les outils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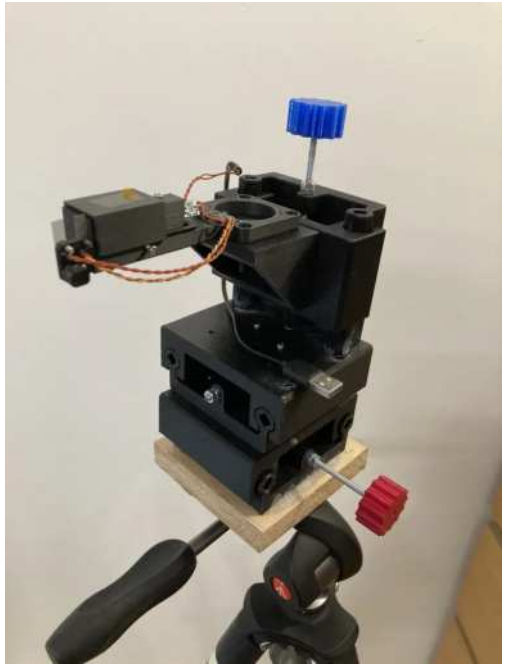
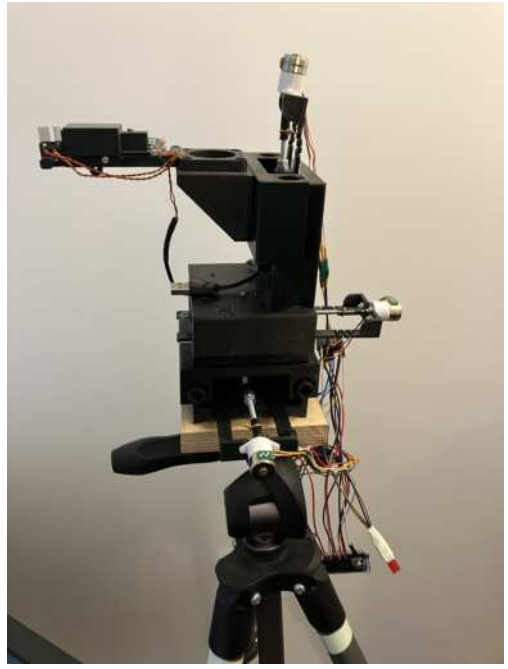
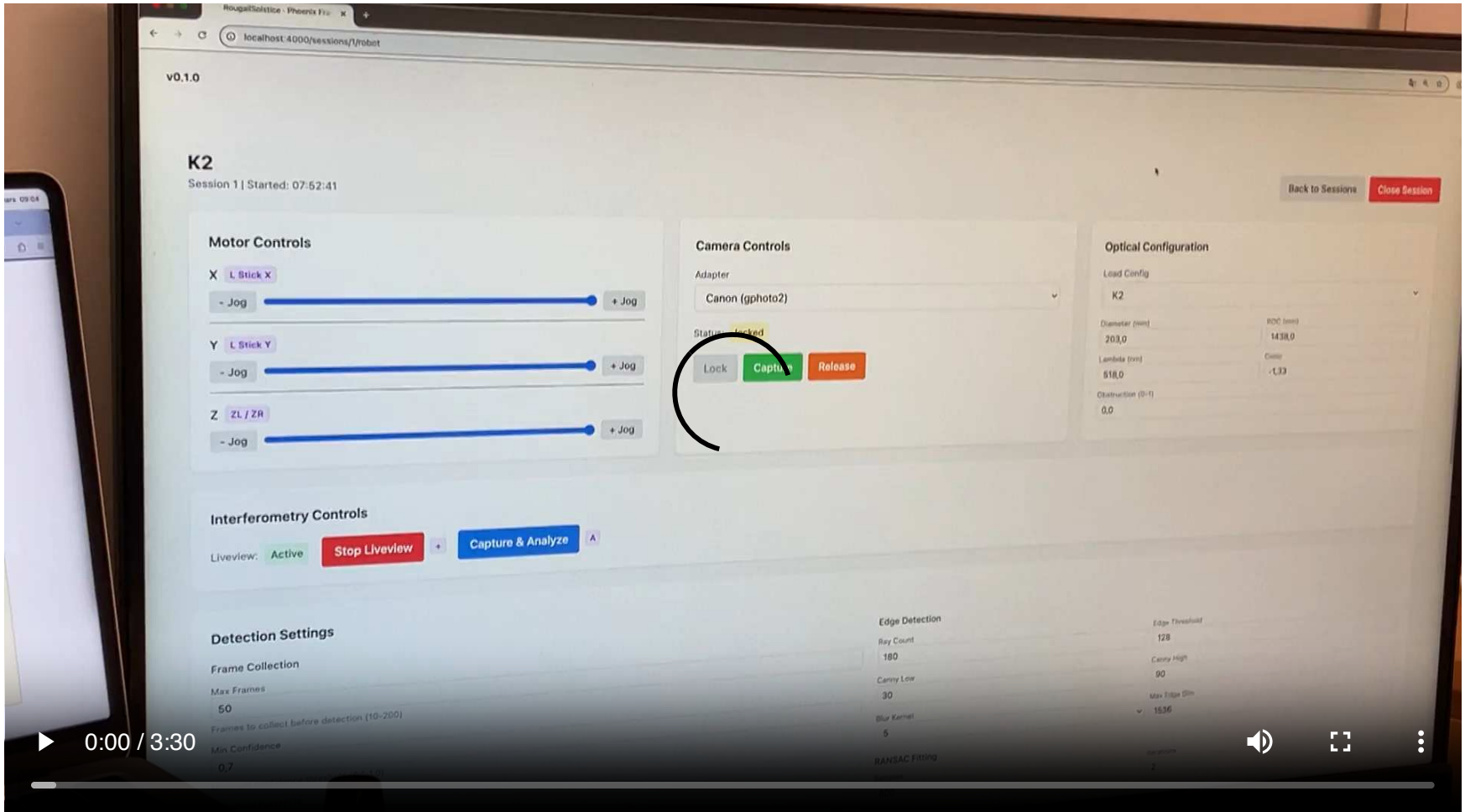
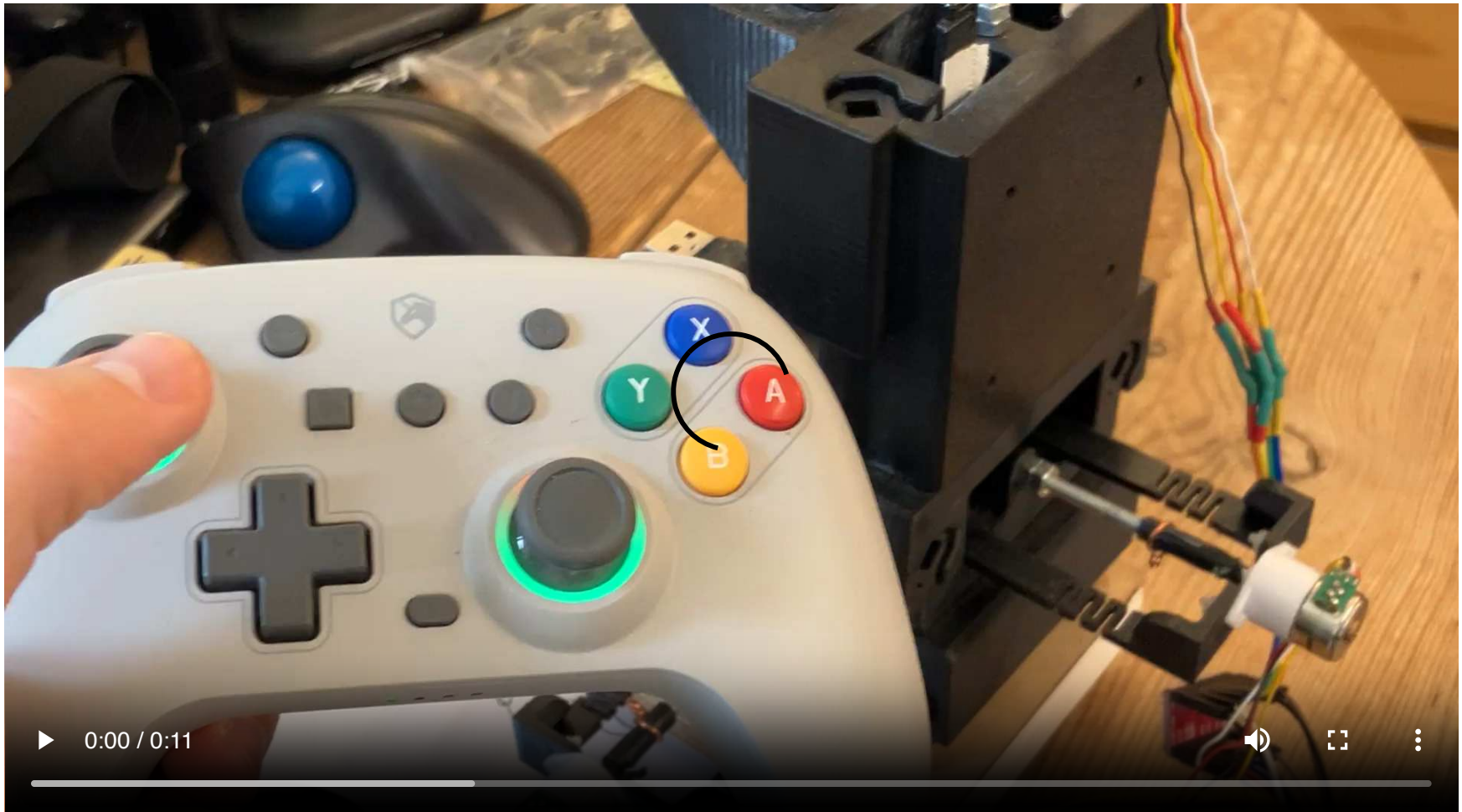
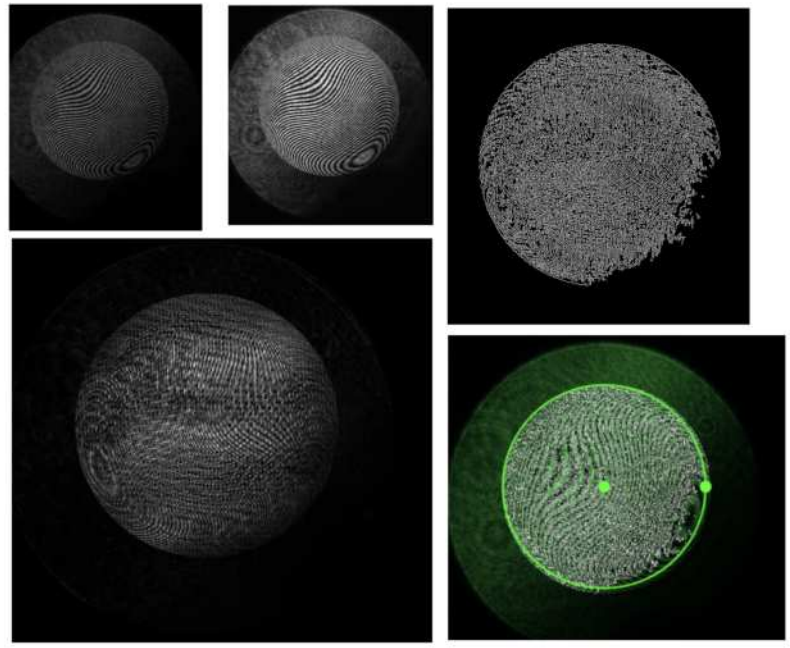


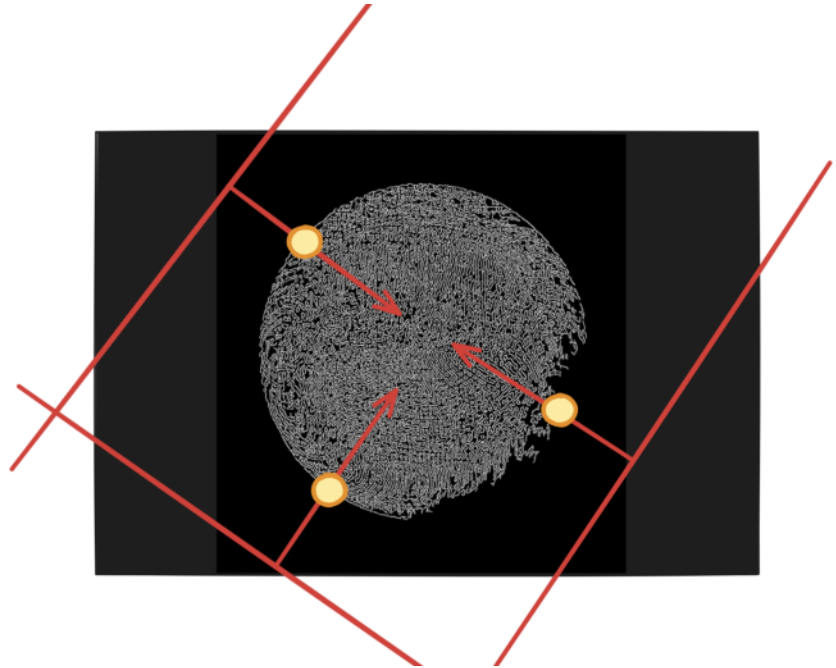



X
Y
A
B


localhost:4000/sessions/1/robot
v0.1.0
K2
Session 1 | Started: 07:52:41
Back to Sessions
Close Session
Motor Controls
X L Stick X
- Jog
+ Jog
Y L Stick Y
- Jog
+ Jog
Z ZL / ZR
- Jog
+ Jog
Camera Controls
Adapter
Canon (gphoto2)
Lock
Release
Optical Configuration
Lead Config
K2
Interferometry Controls
Liveview: Active
Stop Liveview
Capture & Analyze
Detection Settings
Frame Collection
Max Frames
50
Min Confidence
0.7
Edge Detection
Ray Count
180
Canny Low
30
Blur Kernel
5
RANSAC Fitting
Edge Threshold
128
Canny High
90
1536
0:00 / 3:30


X
Y
A
B
0:00 / 0:11





La suite :

- Tester chez un opticien
- Enlever ce qui est inutile
- Développer ce qui est manquant
- Améliorer DFTFringe ?