

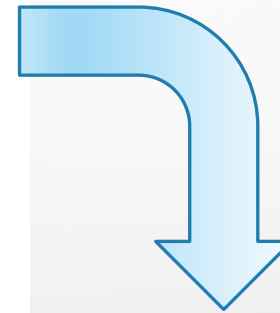
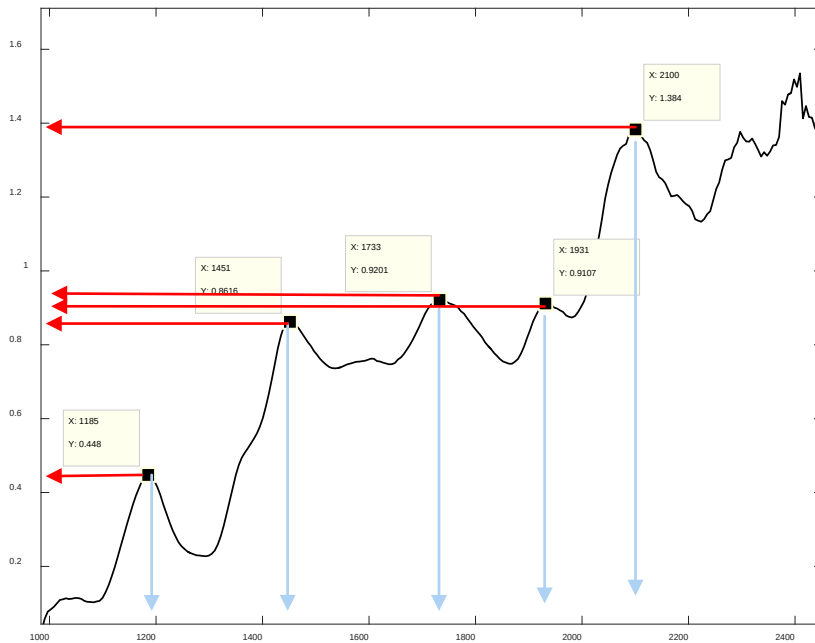
Image hyperspectrale, principe et acquisition

Benoît Jaillais

HelioSPIR, 28-29 juin 2022, Nantes.

De la spectroscopie à l'imagerie spectrale

1 individu = 1 spectre

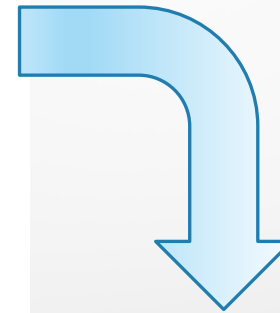
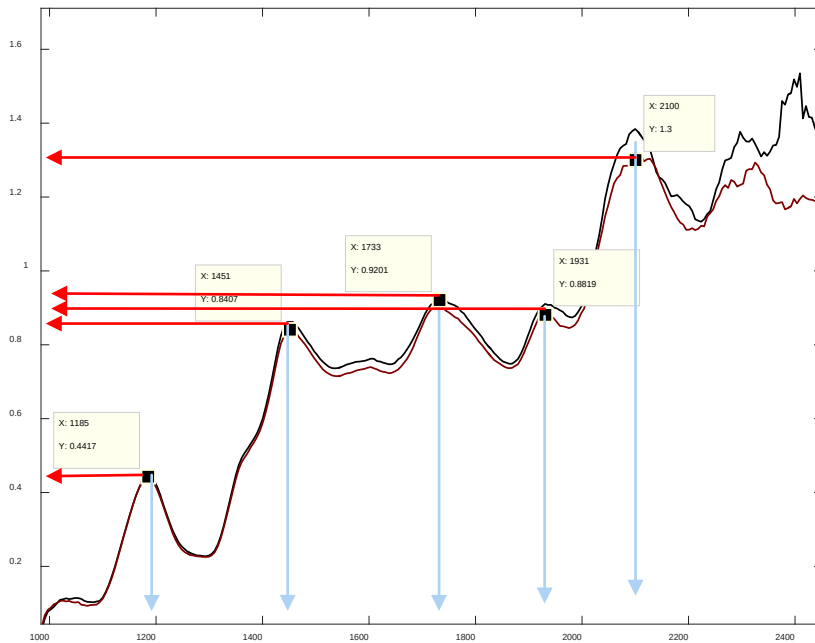


SPIR



Wavelengths	1000	...	1185	...	1451	...	1733	...	1931	...	2100	...	2500
Intensity ind1	...	...	0.44	...	0.86	...	0.92	...	0.91	...	1.38	...	...

2 individus = 2 spectres

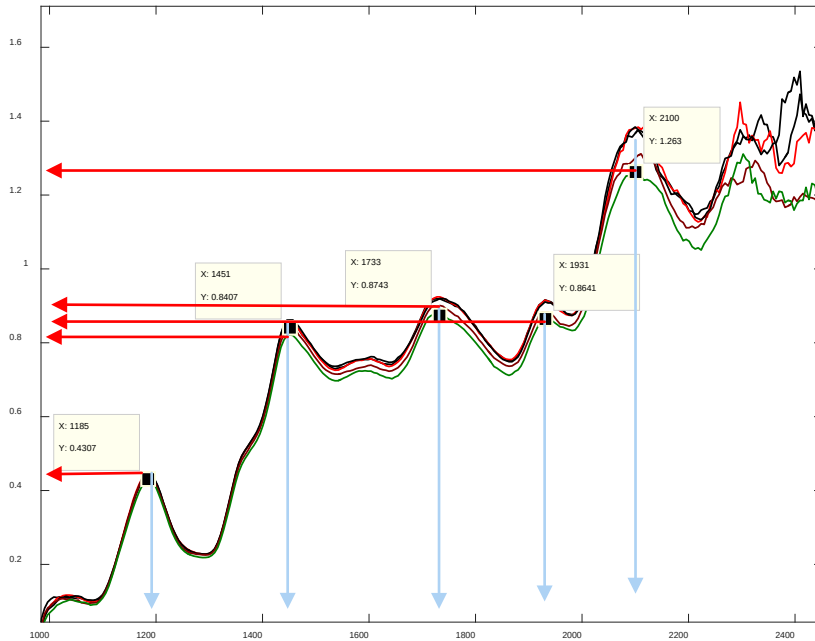


SPIR

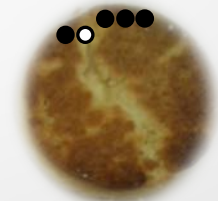


Wavelengths	1000	...	1185	...	1451	...	1733	...	1931	...	2100	...	2500
Intensity ind1	...	...	0.44	...	0.86	...	0.92	...	0.91	...	1.38	...	...
Intensity ind2	...	...	0.44	...	0.84	...	0.92	...	0.88	...	1.3	...	...

5 individus = 5 spectres

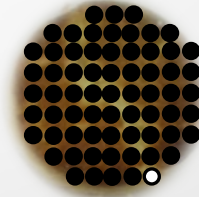
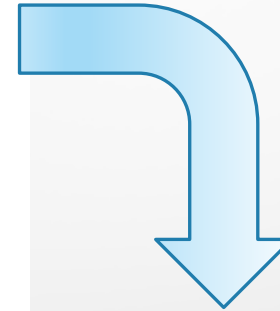
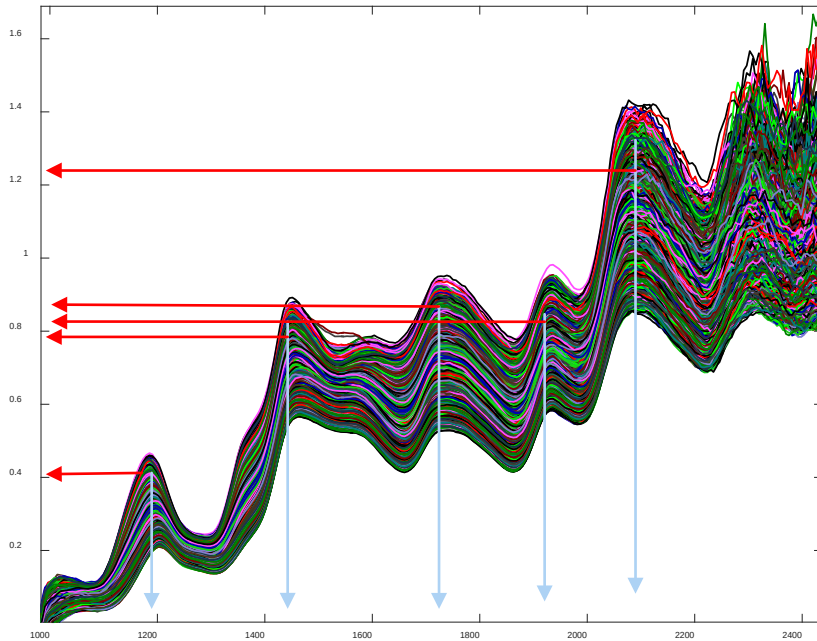


SPIR



Wavelengths	1000	...	1185	...	1451	...	1733	...	1931	...	2100	...	2500
Intensity ind1	...	...	0.44	...	0.86	...	0.92	...	0.91	...	1.38	...	...
Intensity ind2	...	...	0.44	...	0.84	...	0.92	...	0.88	...	1.3	...	...
Intensity ind5	...	...	0.43	...	0.84	...	0.87	...	0.86	...	1.26	...	...

n individus = **n** spectres



Wavelengths	1000	... 1185	... 1451	... 1733	... 1931	... 2100	... 2500
Intensity ind1	...	0.44	0.86	0.92	0.91	1.38	...
Intensity ind2	...	0.44	0.84	0.92	0.88	1.3	...
...	...	...	...	...	...	...	...
Intensity ind5	...	0.43	0.84	0.87	0.86	1.26	...
...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...
Intensity ind n	...	...	...	...	...	...	...

Vue : matrice => cube

En imagerie, les individus sont des pixels de l'image avec un spectre associé.

SI au lieu de ranger les spectres dans une matrice, je les range dans l'image à l'endroit de leur acquisition

Intensity ind4	...	...	...	0.44	...	0.86	...	0.92	...	0.91	...	1.38	...	...
Intensity ind5	...	...	...	0.44	...	0.86	...	0.92	...	0.88	...	1.3	...	...
Intensity ind6	...	...	...	0.44	...	0.84	...	0.92	...	0.91	...	1.38	...	...
Intensity ind7	...	...	...	0.44	...	0.84	...	0.92	...	0.88	...	1.3	...	...
Intensity ind8	...	...	...	0.43	...	0.84	...	0.92	...	0.88	...	1.3	...	...
Intensity ind9	...	...	...	0.43	...	0.84	...	0.87	...	0.86	...	1.26	...	...

λ (288)
950-2500nm
Pas ~6nm

x (280)
~ 51 mm

y (286)
~ 66 mm

Spectre à un point xy

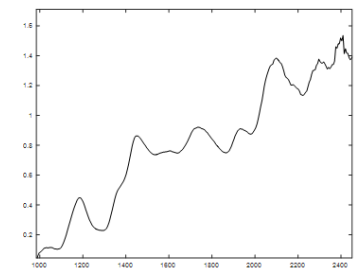
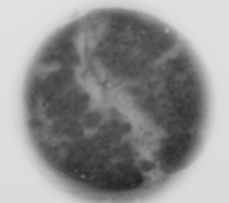


Image acquise à 1440 nm



De l'imagerie à l'imagerie spectrale

Images multi- & hyper- spectrales

Visible
400-800 nm



Image en niveaux de gris

Image RGB



Plan Rouge



Plan Vert



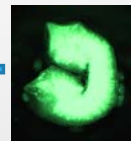
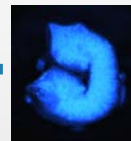
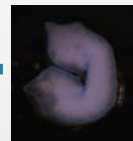
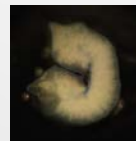
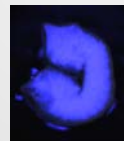
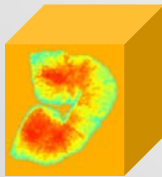
Plan Bleu



3 plans
⇒ Image multispectrale
⇒ ≤ 30 plans spectraux

Visible
400-800 nm

VNIR
360-950 nm



24 plans (8 images RGB)
⇒ Image multispectrale
⇒ ≤ 30 plans spectraux

Image NIR

Plan 1000

Plan 1012

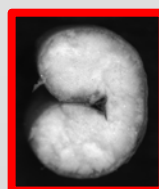
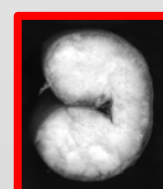
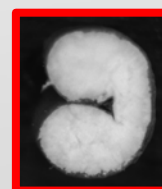
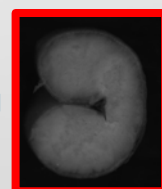
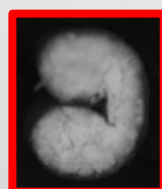
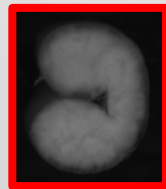
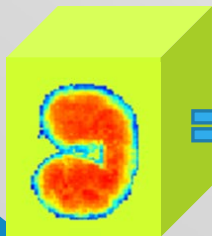
Plan 1024

Plan 1036

...

Plan 2488

Plan 2500

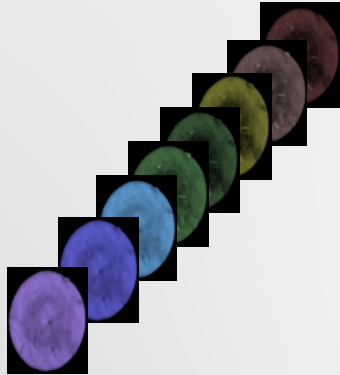


288 plans

⇒ Image hyperspectrale ⇒ > 100 plans spectraux

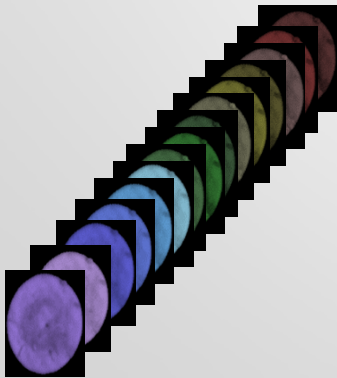
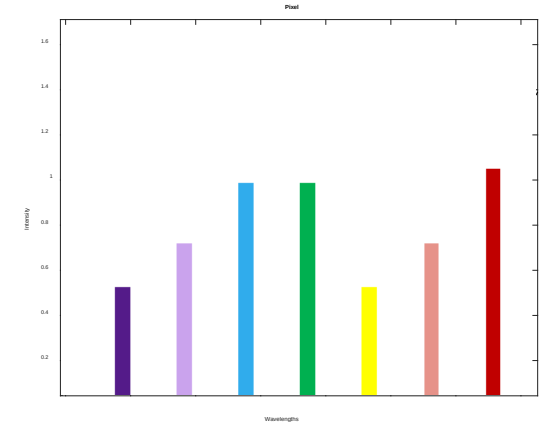
Proche infrarouge
1000-2500 nm

Imagerie multi- vs hyper- spectrale



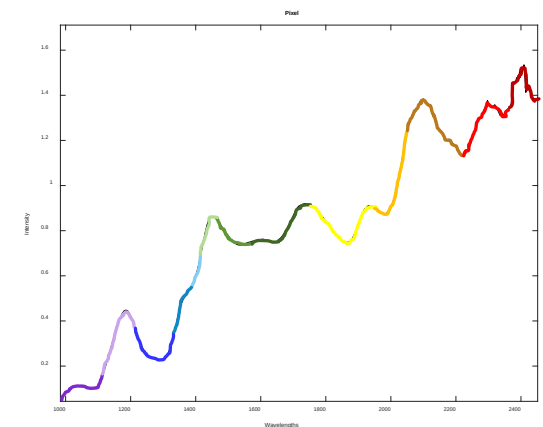
Imagerie multispectrale

↳ N bandes séparées ($N < 100$)



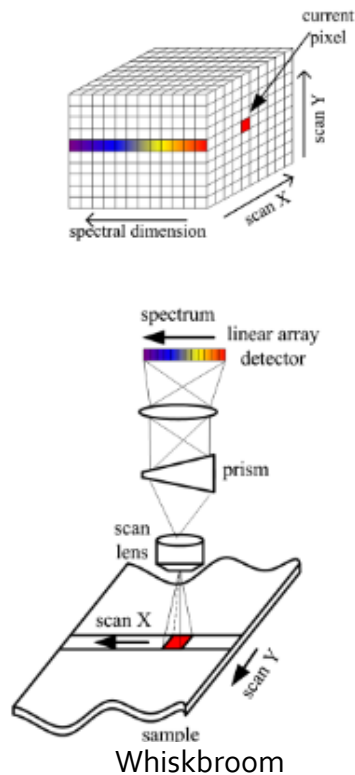
Imagerie hyperspectrale

↳ Spectre continu ($N > 100$)



Acquisition de l'image

Modes d'acquisition



Li, Qingli & He, Xiaofu & Wang, Yiting & Liu, Hongying & Xu, Dongrong & Guo, Fangmin. (2013). Review of spectral imaging technology in biomedical engineering: Achievements and challenges. Journal of biomedical optics. 18. 100901. 10.1117/1.JBO.18.10.100901.

Chimio-métrie image

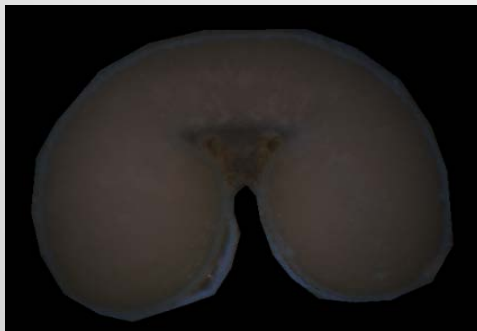
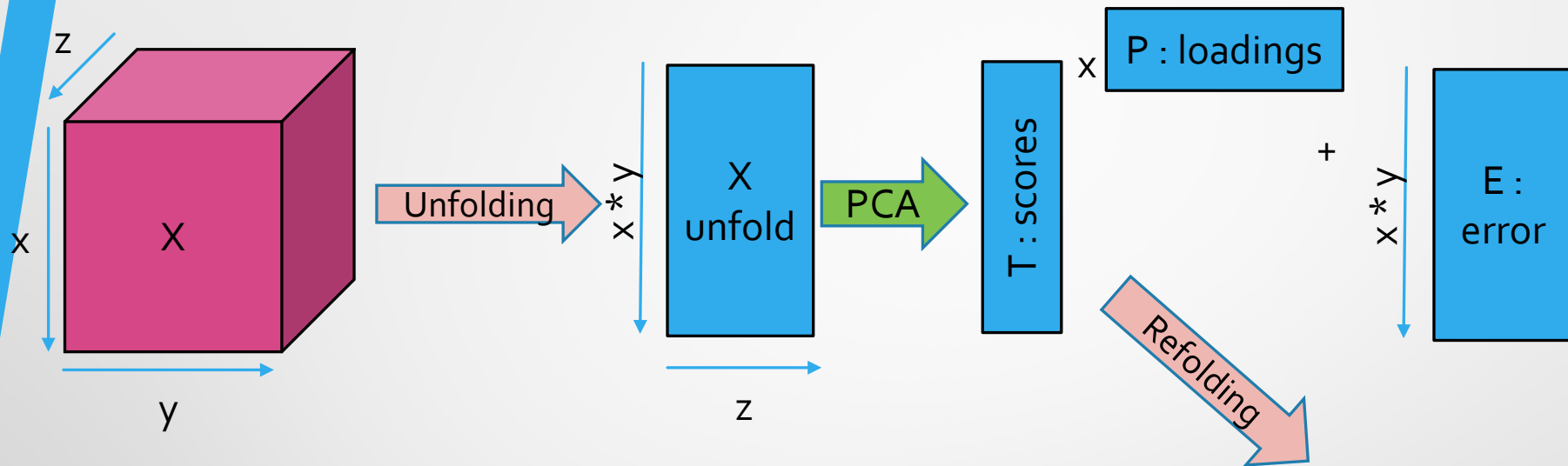


Image originale

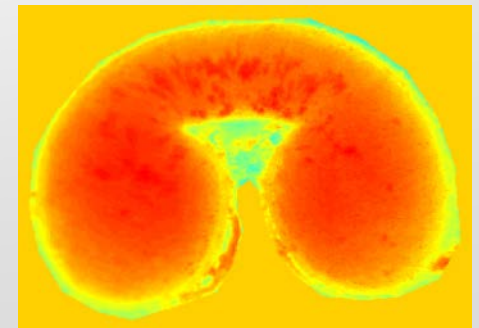
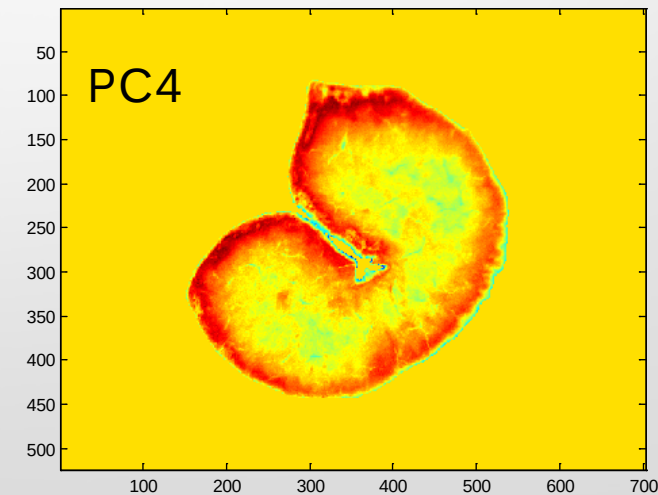
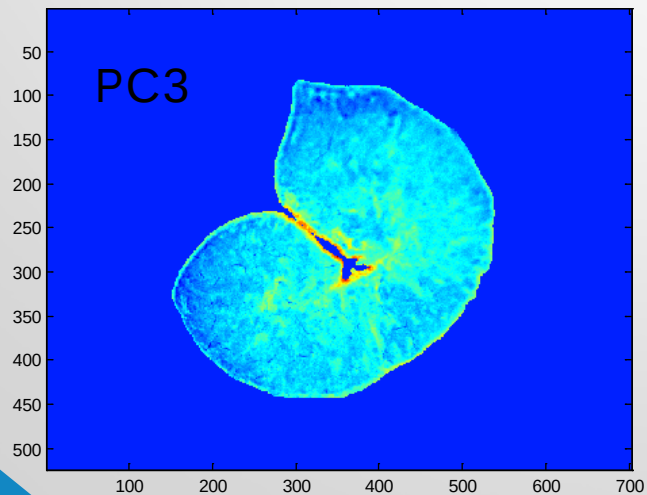
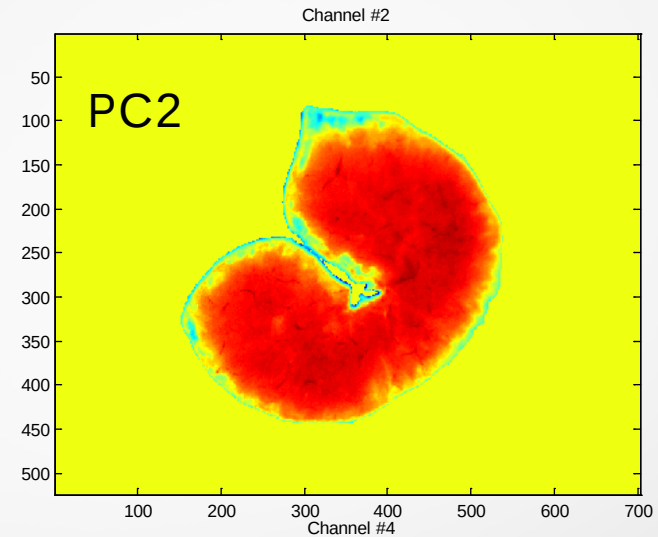
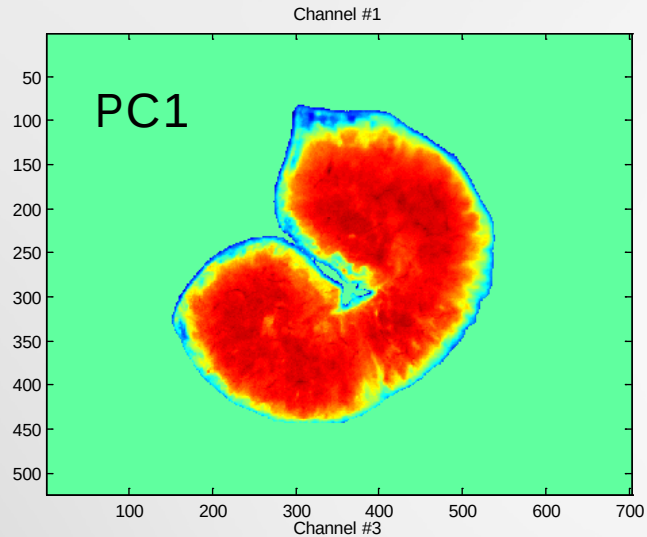


Image score PC1

PC Images-scores





Merci de votre attention