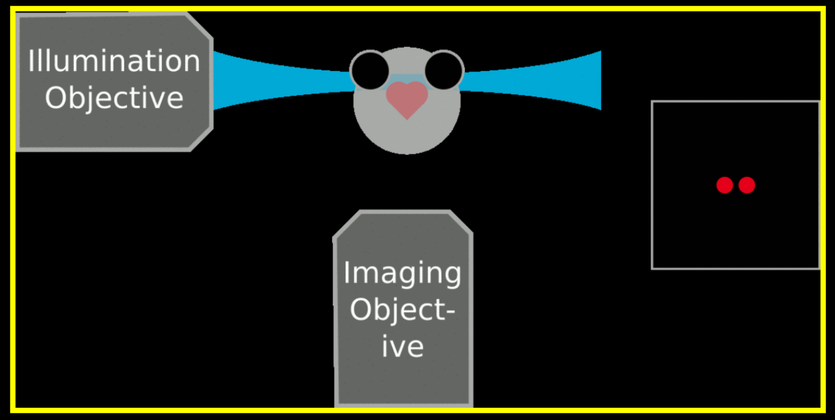
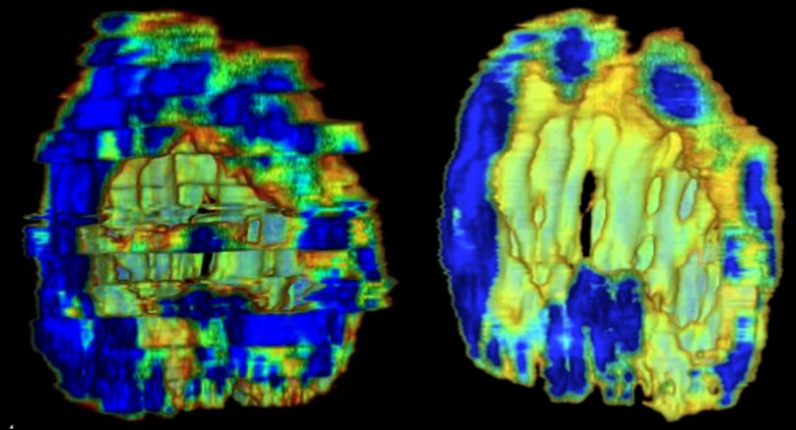
IMAGING THE DEVELOPING HEART

WHY?

British Heart Foundation
Mending broken hearts appeal

HOW?

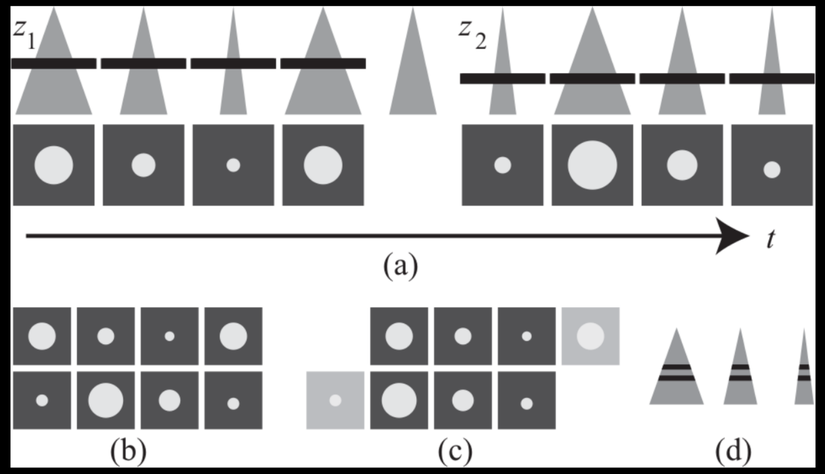




Taylor et al. J. of Biomedical Optics (2011)

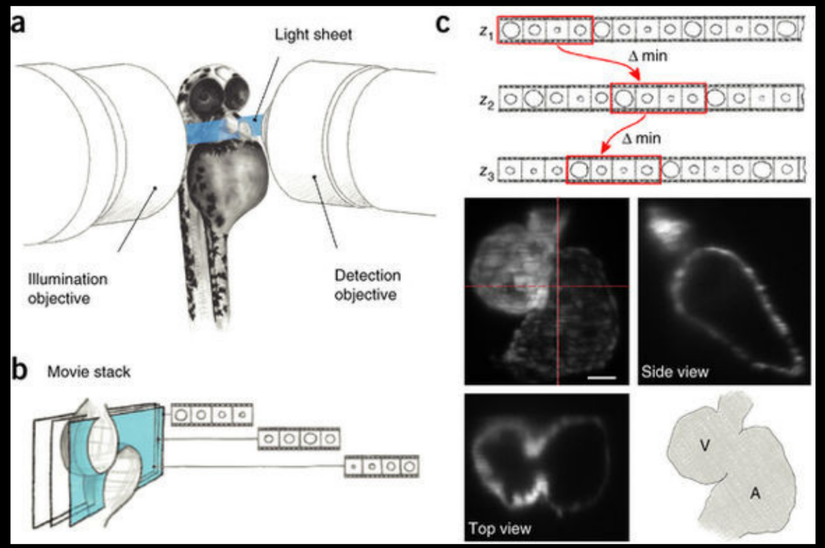
RETROSPECTIVE OPTICAL GATING

RETROSPECTIVE OPTICAL GATING



Liebling et al. IEEE ISBI (2006)

RETROSPECTIVE OPTICAL GATING



Mickoleit et al. Nature (2014)

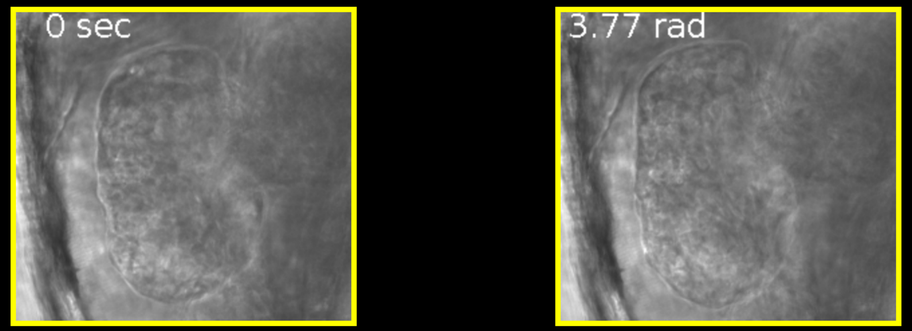
RETROSPECTIVE OPTICAL GATING

- 3D + phase
- High phototoxicity
- High photodamage
- High photobleaching
- Massive data deluge

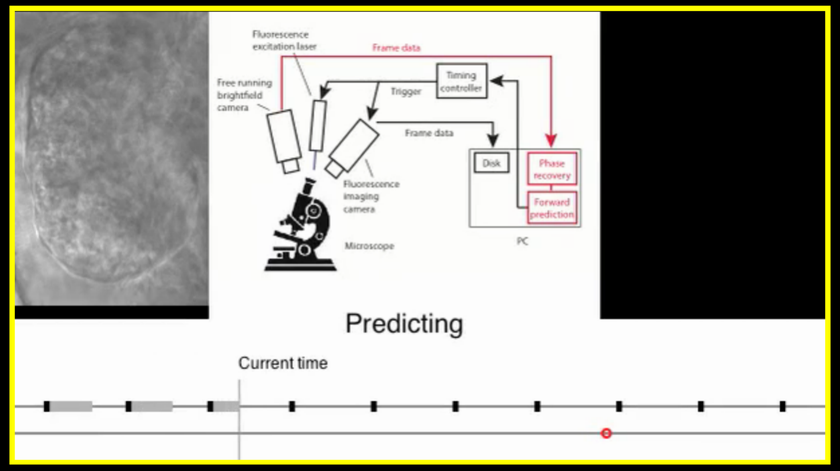
REAL-TIME PROSPECTIVE OPTICAL GATING

REAL-TIME PROSPECTIVE OPTICAL GATING

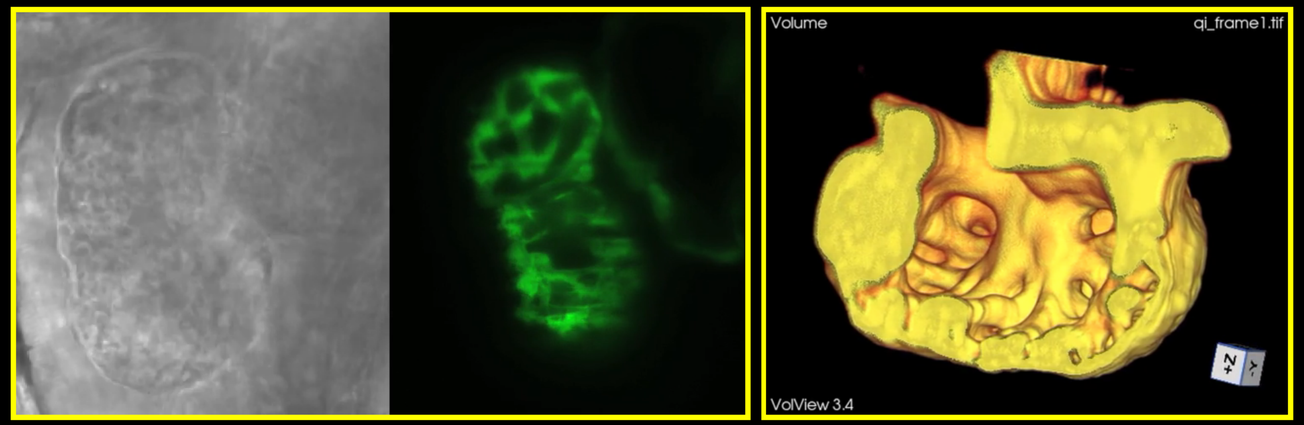
Brightfield Stream Reference Heartbeat (0.25x)



Taylor et al. J. of Biomedical Optics (2011)


Fluorescence excitation laser
Frame data
Timing controller
Free running brightfield camera
Trigger
Frame data
Disk
Phase recovery
Forward prediction
PC
Fluorescence imaging camera
Microscope
Predicting
Current time

REAL-TIME PROSPECTIVE OPTICAL GATING



Taylor et al. J. of Biomedical Optics (2011)

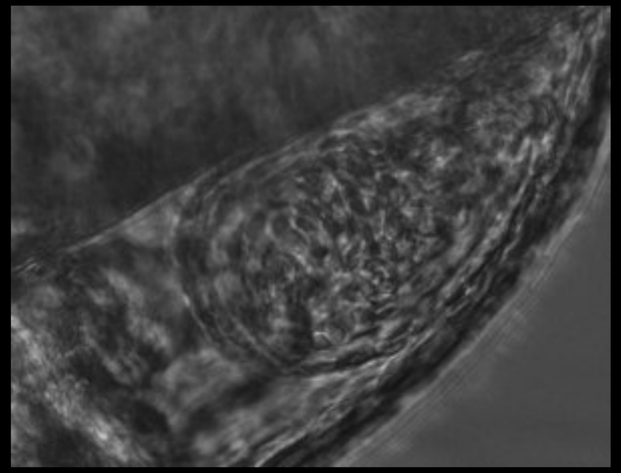
REAL-TIME PROSPECTIVE OPTICAL GATING

- 3D snapshot
- Low phototoxicity
- Low photodamage
- Low photobleaching
- Low data deluge
- ... opportunity for time lapse imaging?

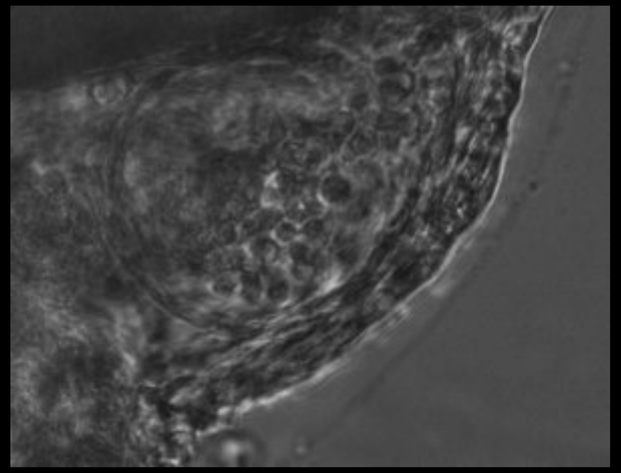
IMAGING THE DEVELOPING HEART OVER HOURS?

JUST PROSPECTIVE OPTICAL GATING

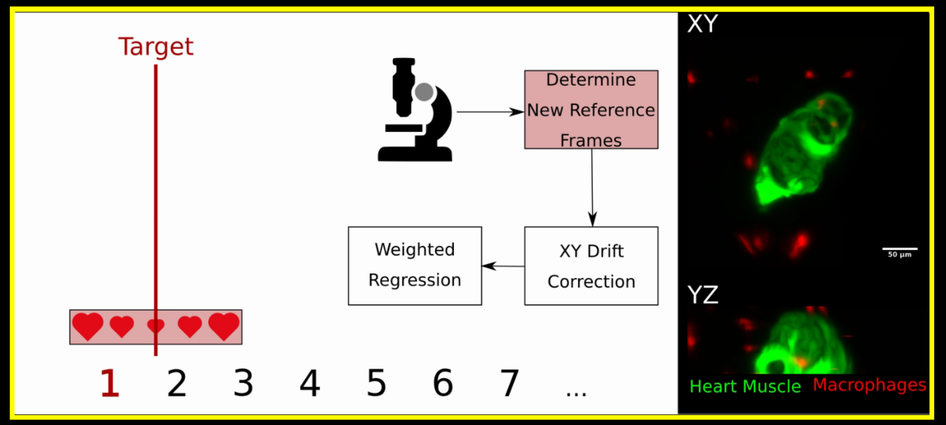
Reference Target Frame



18 hour Target Frame

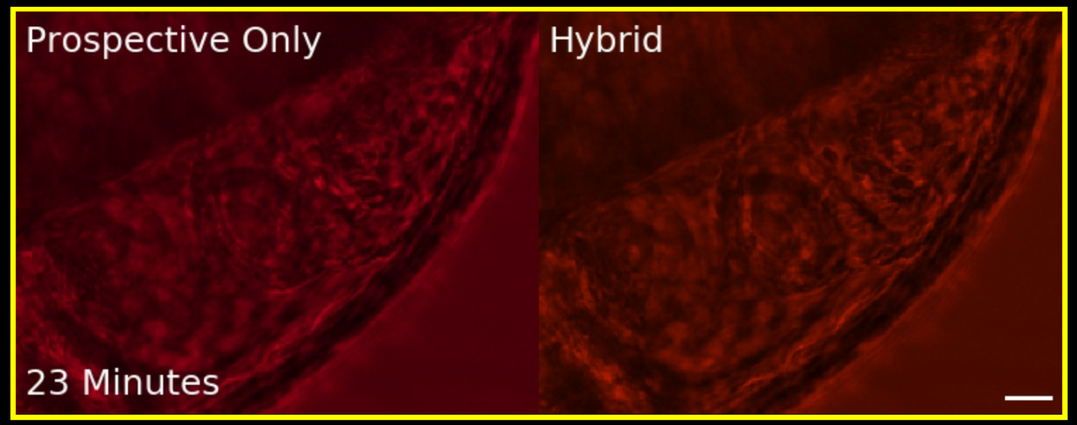


ADAPTIVE PROSPECTIVE OPTICAL GATING


Target
Determine New Reference Frames
XY Drift Correction
Weighted Regression
1 2 3 4 5 6 7 ...
XY
YZ
50 µm
Heart Muscle
Macrophages

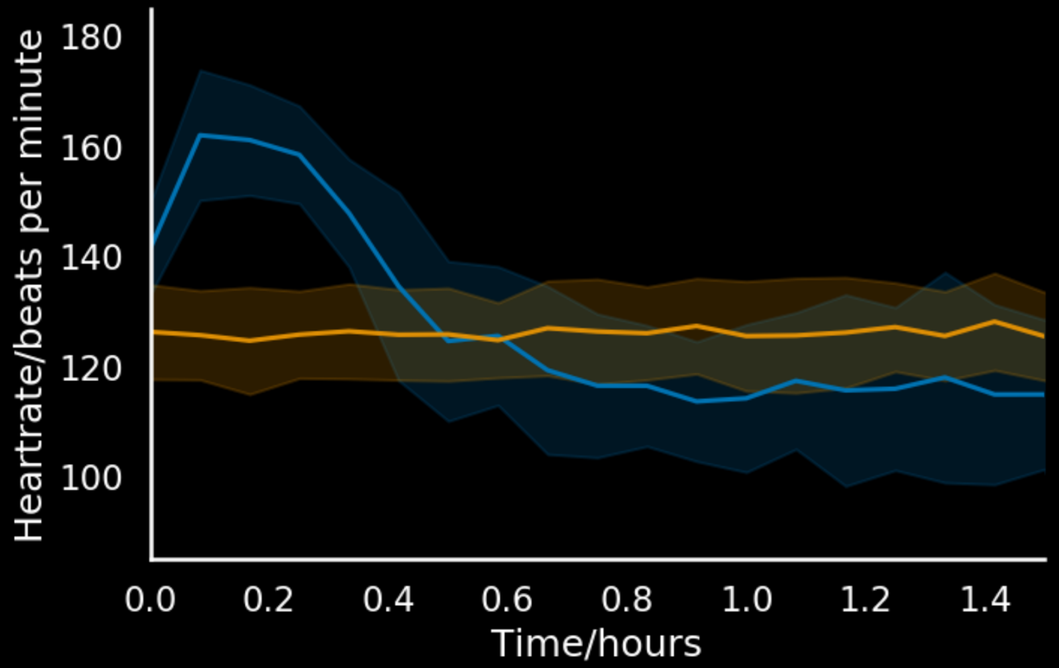
ADAPTIVE PROSPECTIVE OPTICAL GATING

Manual | Automated

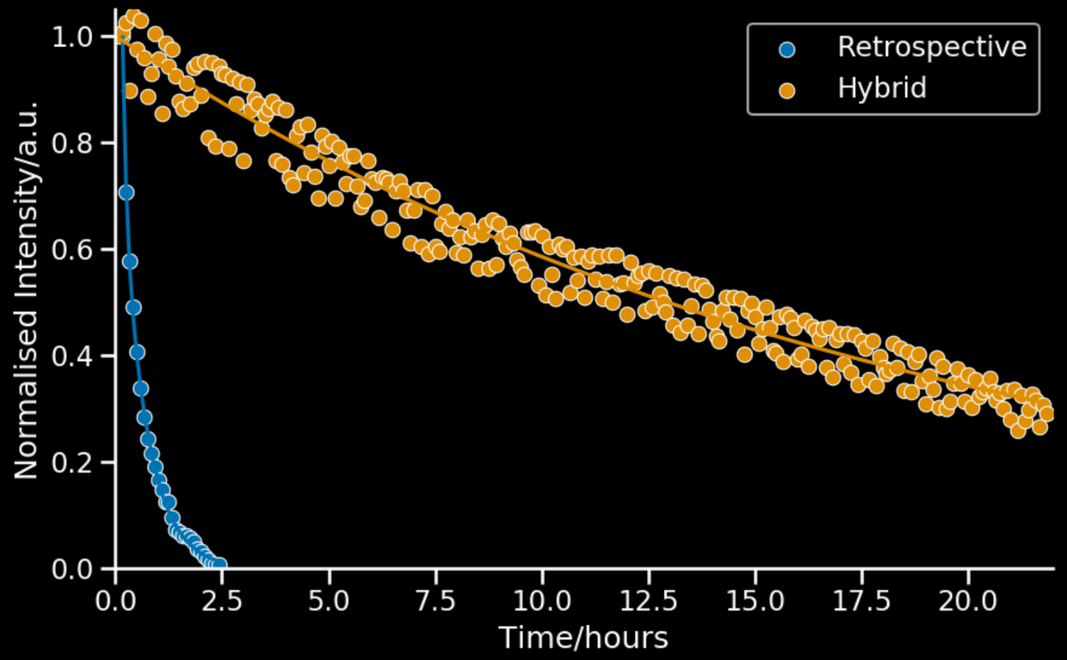


file:///home/chas/git/2018_adaptive-prospective-optical-gating_slides/index.html#/20

PHOTORESPONSE



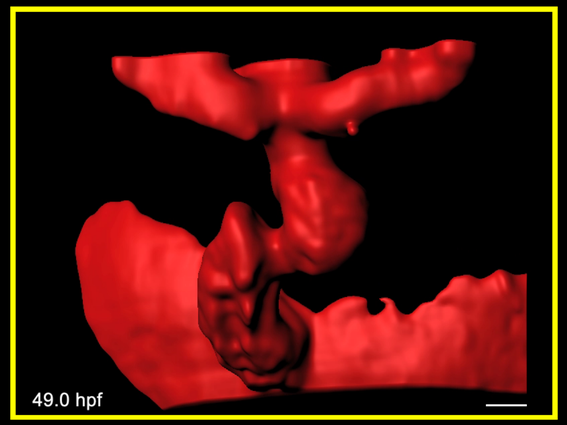
PHOTOBLEACHING

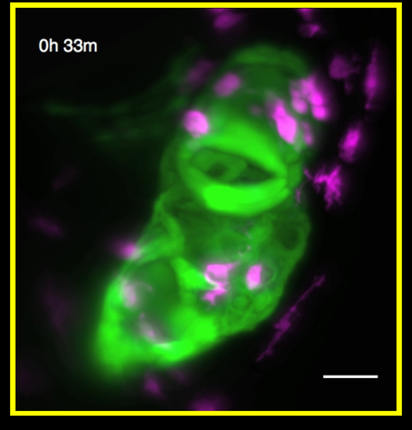


DATA DELUGE

16 TB **80 GB**

24 hours at 3 minute intervals


49.0 hpf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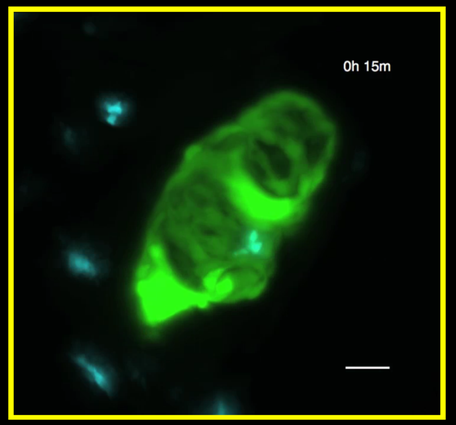
0h 15m

24h 3D timelapse
imaging of
trabeculation
in the beating heart

PREPRINT: BIORXIV 526830

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