ForceTracker : A versatile tool for contractile force assessment in 3D organ-on-chip platforms

J. M. Rivera-Arbelaez [1,2,*], M. Dostanic [3,*], J. M. Stein [4], A. van den Berg [1], L. I. Segerink [1], C. L. Mummery [2,4], P. M. Sarro [3], M. Mastrangeli [3], M. C. Ribeiro [2,5], R. Passier [2,4]

[1]BIOS Lab-on-a-Chip Group, MESA+ Institute for Nanotechnology, Max Planck Institute for Complex Fluid Dynamics, University of Twente, Enschede, the Netherlands; [2]Applied Stem Cell Technologies, University of Twente, Enschede, the Netherlands; [3]Microelectronics, TU Delft, Delft, the Netherlands; [4]Anatomy and Embryology, Leiden University Medical Center, Leiden, the Netherlands; [5]River BioMedics, Enschede, the Netherlands. *Equally contributing authors.

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Introduction

Engineered heart tissue (EHT) structures currently are used to promote maturation of cardiomyocytes (CMs) to resemble *in vivo* conditions [1].

The contractile force is one of the most important factors which determine the maturity of the CMs. The contractile force can be read out from EHT structures by optically tracking the movement of flexible anchors (typically, a set of pillars) upon which the tissues apply the force [2] (Fig. 1).

We present a **robust**, **standardized** and **portable** software for EHT contractile force assessment.
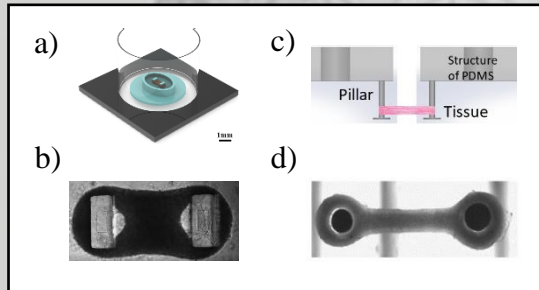

Fig.1 a) EHT platform with rectangular anchors and b) the top view of the compacted tissue; c) EHT platform with circular anchors and d) the bottom view of the tissue

Software realization

- Coded in Python
- Use of multi-threading for time-efficient analysis
- Based on shape-tracking algorithms from OpenCV library
- Compatible with different video formats (.avi and .tiff)
- Analysis outputs: force, speed, time of contraction analysis, and corresponding time series graphs (Fig. 2)
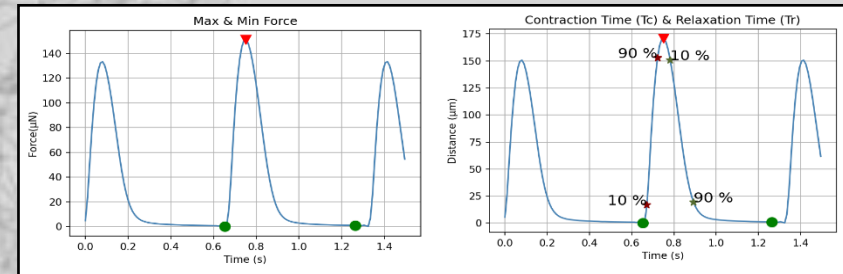

Fig. 2: Examples of two force vs time output graphs resulting from ForceTracker's automated force analysis for EHT grown over anchors with circular cross-section.
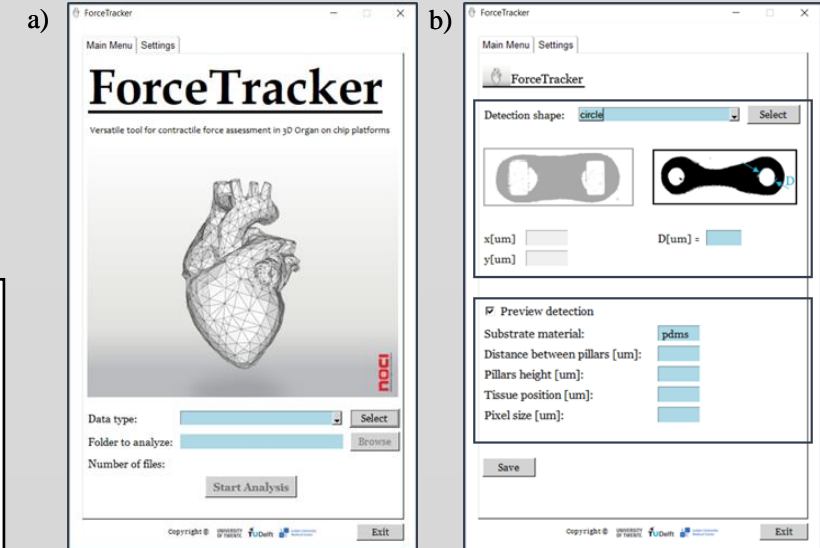

Fig. 3: a) Main menu of the app's user interface. b) Parameter settings tab, with shape definition and settings of the pillars' dimensions and material properties.

Results

- Successful test of the app on multi-format videos from different EHT platforms (Fig. 3).
- Detection and tracking are robust and not affected by common incidental defects.
- Detection accuracy verified using ImageJ.

Scan QR code to see a short demo of the software

Conclusions

We developed and tested *ForceTracker*, an open-source and portable app for analyzing contractile tissue properties in EHT structures. Being a user-friendly, robust and computationally efficient tool, *ForceTracker* represents an important step towards standardized contractile force measurements across various EHT organ-on-chip platforms.

References

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BIOS Lab on a Chip group — AST APPLIED STEM CELL TECHNOLOGIES — EKL Else Kooi Laboratory — UNIVERSITY OF TWENTE. — TUDelft — LUMC Leiden University Medical Center — noci Netherlands Organ on Chip Initiative