Swiss Medtech Day 2016
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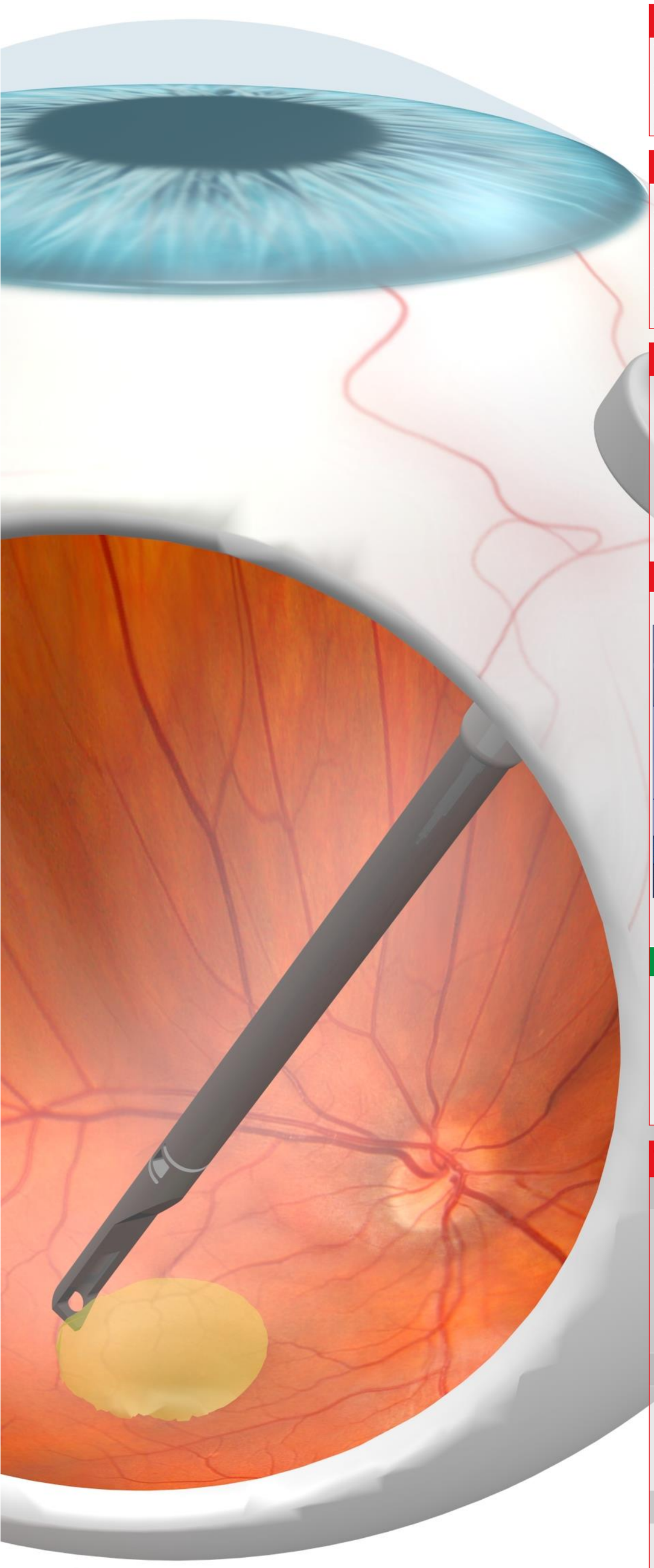
VivoForce

Force sensitive hook for epiretinal membrane peeling in eye surgery

Project management: **Dr Charles Baur** charles.baur@epfl.ch
EPFL – STI – IMT – INSTANT-LAB

Start date 1.09.2014
Duration 2 years

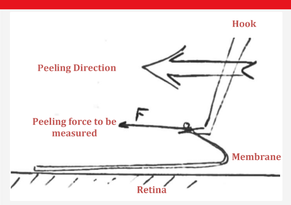


Project goal

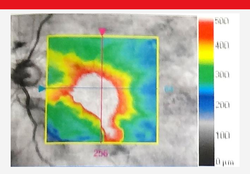
This project addresses the **design, construction and evaluation of a peeling hook with force measurement capability for in-vivo intra-ocular vitreoretinal surgery**. The force sensor consists of a miniature multi-degree-of-freedom flexure where deformations induced by contact forces are measured using optical fiber white light interferometry. This instrument will be used for epiretinal membrane peeling procedures and should then lead to the creation of a new generation of force sensitive surgical tools.

Medical need

Forces exerted onto retinal structures may generate irreversible visual impairment if they exceed specific thresholds. Since these forces are too small to be detected by the tactile senses of the surgeon's hand, they are nowadays estimated based solely on the visual feedback through the microscope. The novel instrument will thus improve patient safety by providing an objective measurement of the exerted forces.



Peeling force


Membrane thickness and location

Proposed solution

In-vivo force sensing surgical instrument

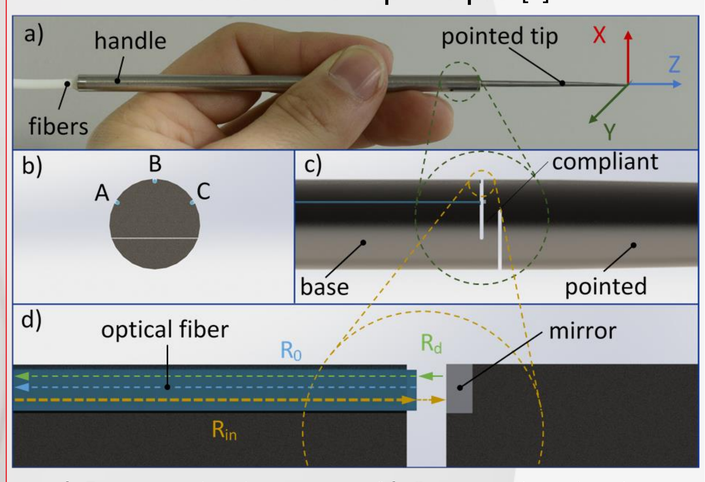
- Force range: 0-15mN
- Measuring resolution: 0.1mN
- Tool diameter: 0.6 – 0.9 mm
- Biocompatible, adapted for liquid environment
- Immune to electric and magnetic noise

Portable interface

- Real-time force value monitoring and chart display
- Audio feedback indicating safety threshold

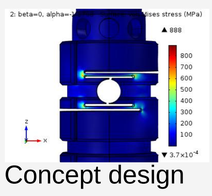
Force measurement using white light interferometry

Measurement principle [1]



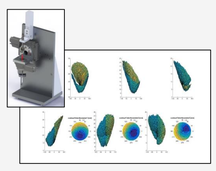
a) Force sensing instrument, **b)** Cross section showing the fiber locations, **b)** Flexure body, **d)** Fabry-Pérot cavity

Instrument development cycle


- Concept design
- FEM/Analytic model


- Manufacturing
- Quality control


- Feedback from medical partner


- Measurements
- Analysis
- Calibration

Forseen benefits

Safer vitreoretinal surgery

- Real-time feedback of peeling forces
- Information on forces below human perception
- Quantification of the tissue properties

Overall clinical impact

- Prevent retinal tissue damage
- Ameliorate visual recovery

Improved training of surgeons

- Correlation of surgical outcome with excerted forces
- Faster learning curve
- Standardization: correlate forces with surgical parameters

Team

Research partner

Instant-Lab
instantlab.epfl.ch


Prof. Simon Henein


Dr Charles Baur


Marine Clogenson


Sebastian Fifański


José Rivera

Industrial partner

sensoptic.ch


Dr Axel Bertholds CEO


Micro. Eng. EPF Pere Llosas

Medical partner

Hôpital ophtalmique Jules-Gonin
Service universitaire d'ophtalmologie
Fondation Asile des aveugles
asile-aveugles.ch


Prof. Thomas Wolfensberger

Swiss Confederation
Commission for Technology and Innovation CTI
kti.admin.ch

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References:
[1] S. Fifanski, J. Rivera, M. Clogenson, C. Baur, A. Bertholds, P. Llosas, S. Henein: Flexure-based multi-degrees-of freedom in-vivo force sensors for medical instruments. Euspen's 16th Conference & Exhibition, Nottingham, UK, May 2016

[2] Optical force sensing element and microsurgical instruments, EP 12171195.6, Bertholds A., Llosas P. and Henein S., Patent Pending. Holder: Sensoptic SA (2012)

[3] Optical measuring element having an integral structure, US12/919.621 EP 02255170, Bertholds A. & Llosas P., Henein S., Patent Holder: Sensoptic SA (Losone, CH) (2009).