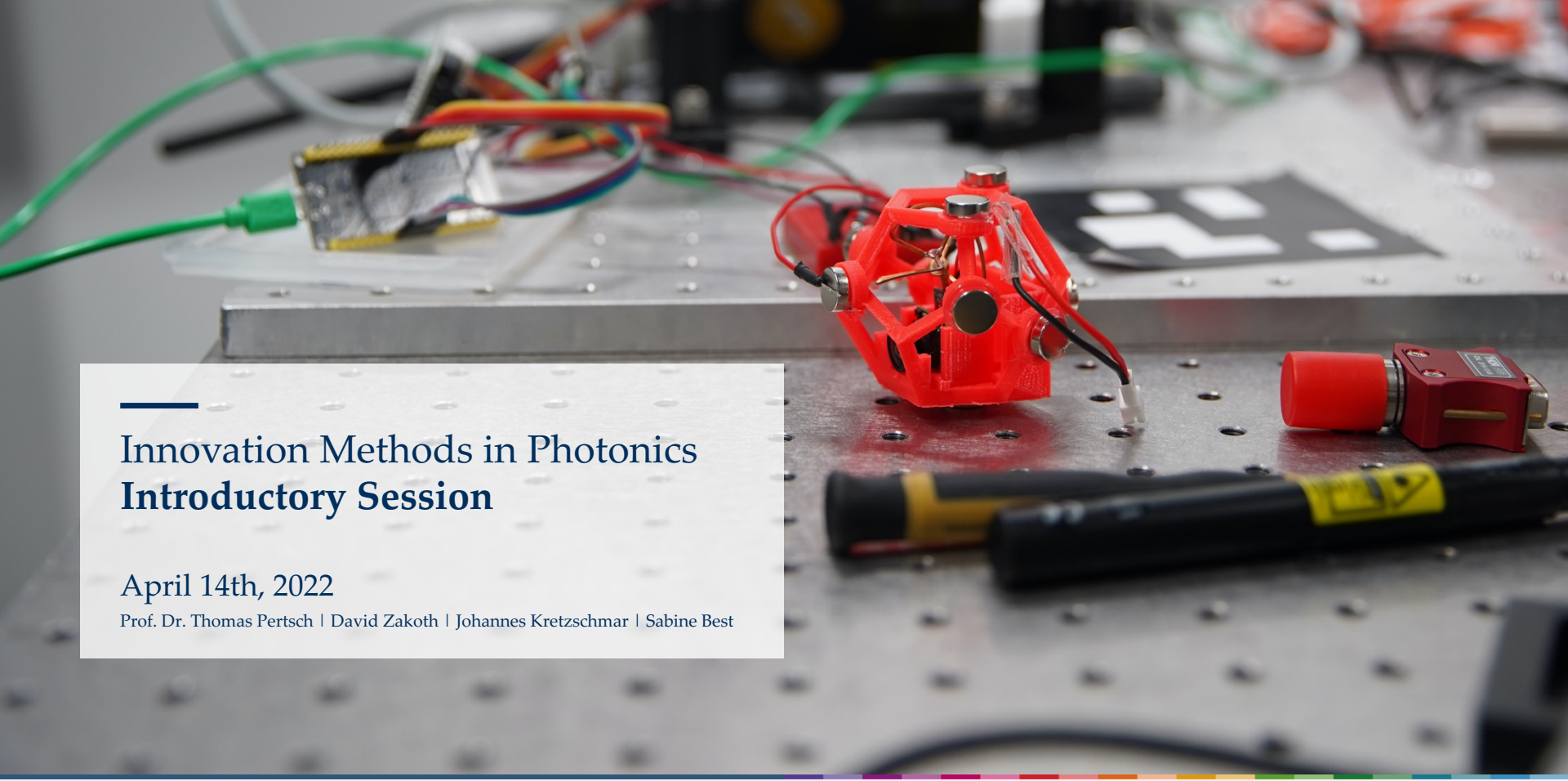

Innovation Methods in Photonics
Introductory Session

April 14th, 2022

Prof. Dr. Thomas Pertsch | David Zakoth | Johannes Kretzschmar | Sabine Best

Team and contact

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INNOVATION METHODS in PHOTONICS

Summer semester 2022 | Thursdays 12PM – 4PM

Specialisation course | 4 CP | M.Sc. Photonics & Physik

ENROLL NOW LECTURE 186797 | EXERCISE 186798

Theory meets Makerspace

Lectures

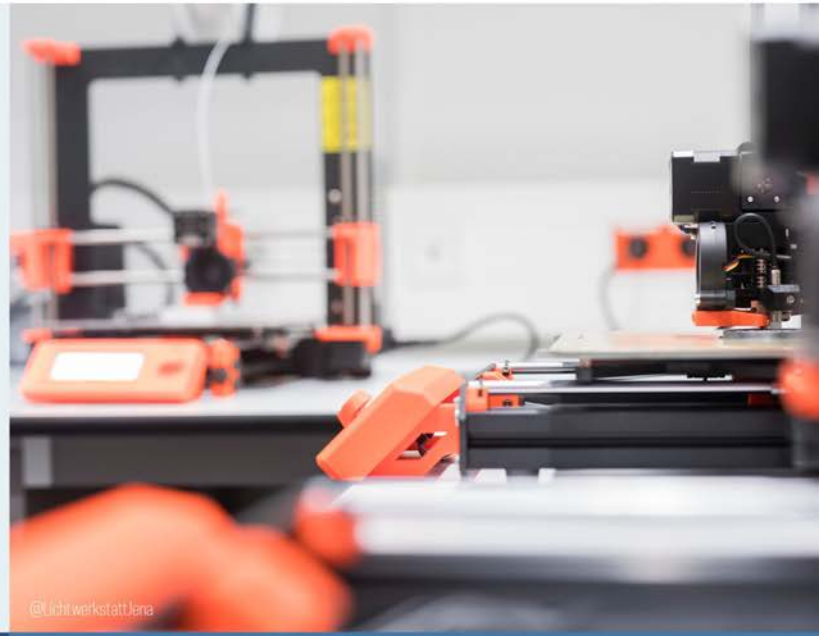
- Innovation management
- Entrepreneurship
- Project management
- Business modelling
- Intellectual property rights

Workshops

- Rapid prototyping technologies (such as 3D scanning and printing, laser cutting, microcontrollers)
- Creativity methods

Innovation Challenge

Work hands-on in small teams on your own photonics innovation project!



FRIEDRICH-SCHILLER-UNIVERSITÄT JENA

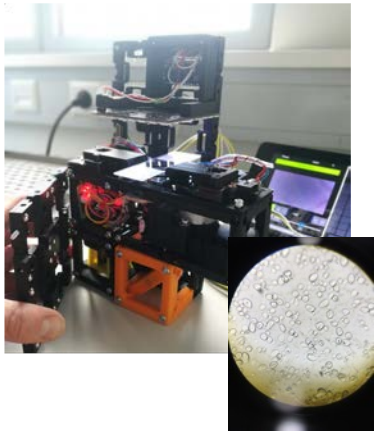
Abbe School of Photonics | JENA
Friedrich-Schiller-Universität

LICHTWERKSTATT | JENA
OPEN PHOTONICS MAKERSPACE

For more information visit
www.lichtwerkstatt-jena.de

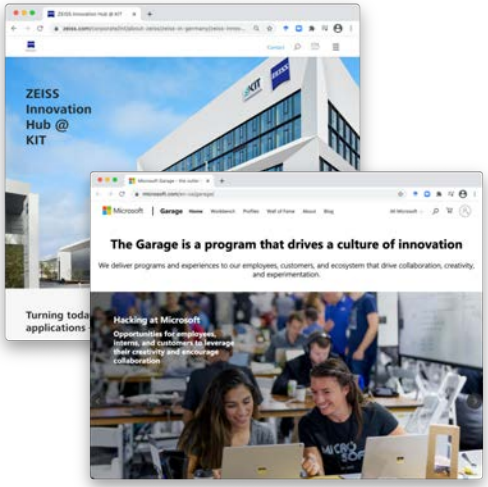
Reasons why the IMiP skills are useful in your future careers whether you are becoming a …

Researcher



Entrepreneur

Industry Employee



Schedule

No	Dates / Time	Topic	Lecturers
1	14.04.2022 12.00 – 14.00	**Introductory session** Presentation Challenges	Lichtwerkstatt Team **Challenge providers**
2	21.04.2022 12.00 – 16.00	**Workshop** Design Thinking	David Zakoth & Sabine Best (Lichtwerkstatt) **Challenge providers**
3	28.04.2022 12.00 – 14.00	ONLINE **Lecture** Introduction to Innovation Management	Prof. Oliver Mauroner (University of Applied Sciences Mainz)
4	05.05.2022 12.00 – 16.00	**Workshop** Introduction to 3D printing	Johannes Kretzschmar (Lichtwerkstatt)
5	12.05.2022 12.00 – 14.00	ONLINE **Lecture** Introduction to Project Management	Marie-Luise Kanbach (Fraunhofer IMW)

Schedule

No	Dates / Time	Topic	Lecturers
6	19.05.2022 12.00 – 16.00	**Workshop** Introduction to Lasercutting	Johannes Kretzschmar (Lichtwerkstatt)
	26.05.2022	*Ascension Day /Himmelfahrt*	
7	02.06.2022 12.00 – 14.00	**Lecture** Introduction to Entrepreneurship **Practical example** Entrepreneurship	Dr. Sebastian Händschke (Fraunhofer IOF, Digital Innovation Hub Photonics) Jan Sperrhake (XSight Optics)
8	09.06.2022 12.00 – 14.00	**Lecture** Overview of Intellectual Property Rights **Practical example** Intellectual Property Rights	Dr. Christian Luitik & Dr. Oliver Pänke (FSU Jena) Dr. Kevin Füchsel (Quantum Optics Jena GmbH)
9	16.06.2022 12.00 – 16.00	**Workshop** Business Modelling	Prof. Oliver Mauroner (University of Applied Sciences Mainz) David Zakoth & Sabine Best (Lichtwerkstatt)

Schedule

No	Dates / Time	Topic	Lecturers
10	23.06.2022 12.00 – 16.00	**Workshop** Rapid Prototyping – project specific	Johannes Kretzschmar (Lichtwerkstatt)
11	30.06.2022 12.00 – 14.00	**Teamwork in the Makerspace** Mentoring, Q&A, Special Knowledge	Lichtwerkstatt Team
12	07.07.2022 12.00 – 16.00	**Teamwork in the Makerspace** Mentoring, Q&A, Special Knowledge	Lichtwerkstatt Team
13	14.07.2022 12.00 – 16.00	**Final presentations**	Lichtwerkstatt Team **Challenge providers**
	28.07.2022 12.00 – 16.00	**Exam**	Abbe Center of Photonics, Auditorium
	29.09.2022 13.00 – 15.00	**Retry exam**	Abbe Center of Photonics, Auditorium

Workload for the students

Type of Workload	Hours
In-class studying	45
Independent studying (incl. preparations for examination, project work, documentation and reporting)	75
Total	120

Requirements for awarding credit points

Type of Examination	Percent
Presentation (Team), 14.07.2022	30%
Short Project Reports (Individual), weekly	30%
Written Examination (Individual), 28.07.2022, Retry exam 29.09.2022	40%
Total	100%

IMiP 2022
Practical Part

Dipl.-Inf. Johannes Kretzschmar
johannes.kretzschmar@uni-jena.de
03641 / 9-47577
ACP 201

-> MOODLE

-> DISCORD

STEP 1 : Time Management

4 ECTS Points -> 120h

75h besides Lecture/Workshops

-25h Prep time for Exams/Lectures

-> 50h or 5h/week IMiP project

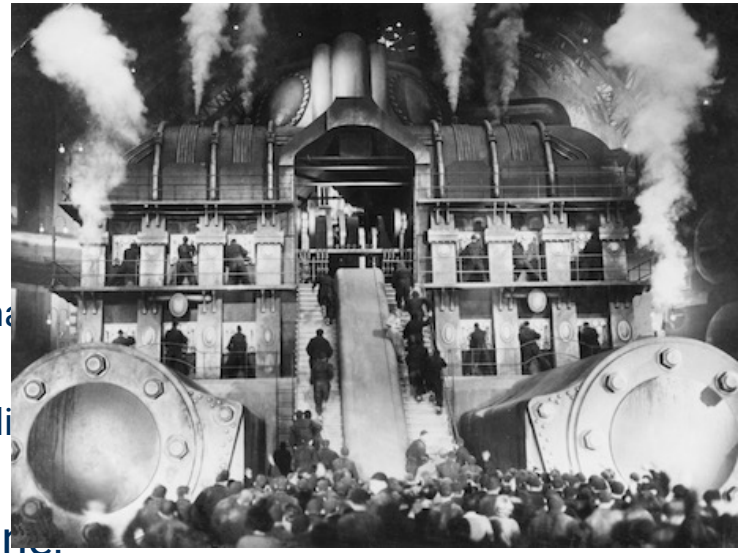
-> 4h work + 1h meeting, doc, prezi

-Find fixed spot(s) to put **4h** in your week schedule

- Splitted or as whole
- Communicate and Synch with Team Members

STEP 2 : Workload Management

- Reguarly define Tasks to do with your Team
- Agile Dev Rules:
  - As precise and non-trivial as possible!
  - Split large tasks into smaller ones
    (Description fits on a Post-It)
  - Estimate time for packages accordingly (0.5 – 4h ma
  - Try to define workload, that fits in a week (4h)
  - **Each** Task for only **One** Team Member! (Responsibili
- Having a workload of less then 4h/week is fine,
  but please try to catch up asap.



S **Title** , **Time and Person** involved GING

Integration of ESP32 Cam (3h) by Tyson

- Designed Mount for ESP Cam in UC2Cube (based on https://github.com/openUC2/...)
- Front and Backplate, since ESP Cam Module has now mounting holes
- Printed ESP32cam_UC2.stl on PrusaMK3 (see pic)
- Attempted to get the code from Jari working, however I was getting many errors and wasn't able to fully debug it. I did find a different example that I did get to work and was able to view stream through the ESP camera (see cam32.ino)
- Talk to Jari about code.

Log any Task **accomplished!**

Link used **Ressources**: Articles, Books, URLs, Repos, YouTube Videos, TikToks

Learnings, which might be reasons for later design & process decisions

Add or Link **Proof of Work** = Designs, Source Code, Pictures, Movies, Screenshots, Sketches, etc.

Note **Failures** (!!!) and Solutions or Implications on further Progress.

Future Tasks

SEND LOGS

Log File
For Week

Text,
Markdown,
Excel, TeX-
PDF,
as you like.

Additional Files,3D-Models, JPGs, MP4s, Source Code, etc.

ZIP File, for whole team or individual

DEADLINE:
3AM before IMiP
(starting A
2

johannes.kretzschmar@uni-jena.de

BE CAREFUL WITH INTELLECTUAL PROPERTIES!

pository

FOR PROFESSIONALS

LARGE FILES:
Please Use Cloud Service!
(cloud.uni-jena.de, upload.uni-jena.de)

GitLab
git.uni-jena.de

GitHub

No formal requirements, no stylesheets. Find your way!

Do not put too much time into logs. Keep ´em short and simple. #kiss

Feedback will be given if necessary or asked for.

WHY?

You and Your Team

- Learn Agile Dev on the go! ☺
- Reflect your work
- Review work of team members
- Communicate current state of project progress
- Archive of Ressources & Best Practices
- Tons of Material for final Project Presentation

Project Mentors

- Follow Progress without time consuming status meetings
- Documentation
- Reproducability for further Development

- Documentation (no explicit documentation compared to IMiP 2021)
- Current State of Progress (Overview will be given ahead of every Workshop)
- **Grading**

GRADING your project work

We will not grade:

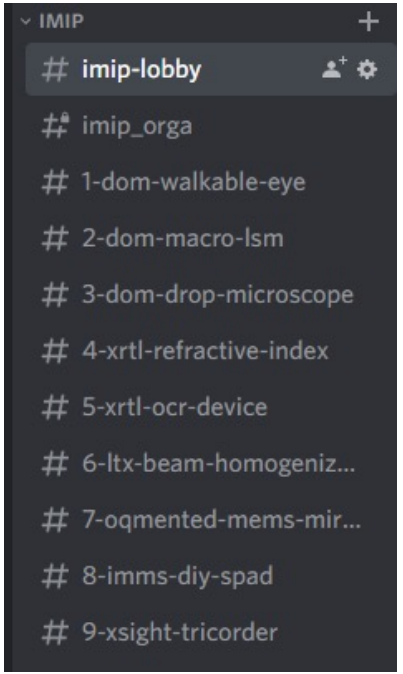
- Particular „final“ state of final project
- Difficulty of Work Packages
- Actually used methods or tools

We will grade:

- As Individually as possible
- Steady goal-oriented progress over the whole semester
- **Comprehensible** and **Reproducible** Project Logs
- How you identified Failures and how you adapted and solved issues
- Assessment of the mentors

FINAL REMARKS

https://discord.com/invite/qfcjk7TtuX



Fuzzyness and nature of IMiP is intended and will be noticed!

Communication is everything!

- Organizational Matters
- Access to Lichtwerkstatt
- Purchasing of Parts, Tools, Materials…
- Problems in your Team
- Changes regarding your Attendance of IMiP
  - Withdrawal
  - Attend without ECTS Points

Try to have fun. It helps ☺

Innovation Projects

5min presentation + 2min Q&A

1. D.O.M.: Build the prototype of a functionable, interactive and walkable human eye.
2. D.O.M.: Build an interactive macroscopic light-sheet microscope.
3. D.O.M.: Build a water drop-based microscope for our new exhibition.
4. Lichtwerkstatt | digiPHOTON: Determination of Refractive Index with Remote Michelson Interferometer.
5. Lichtwerkstatt: Integration of Measurement Devices into Digital Twin of Lab Experiments.
6. Lastronics: Build a beam homogenization using (partially) coherent light sources.
7. OQmented: Controlling a MEMS Mirror System.
8. IMMS | MAQUERSPACE: Do It Yourself Single Photon Detector with Active Quenching.
9. Xsight Optics: Medical tricorder - a handheld sensor for contactless heart rate monitoring.

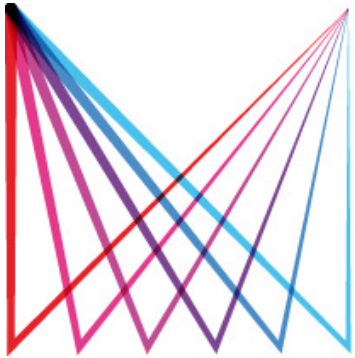
moodle → Select your project preferences

Innovation Challenges Presentations

1 – 3

DOM

Innovation Methods in Photonics
Challenges by D.O.M.



DEUTSCHES
OPTISCHES
MUSEUM

Prof. Dr. Timo Mappes & Team
Deutsches Optisches Museum
April 14th, 2022

Innovation Methods in Photonics
Challenges by D.O.M.

DEUTSCHES OPTISCHES MUSEUM

1	Deutsches Optisches Museum (D.O.M.)
2	Exhibition
3	Challenge 1: optically working eye model
4	Challenge 2: interactive macroscopic light-sheet microscope
5	Challenge 3: water drop-based microscope

Innovation Methods in Photonics
Challenges by D.O.M.

DEUTSCHES OPTISCHES MUSEUM

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DEUTSCHES OPTISCHES MUSEUM

Foundation Deutsches Optisches Museum (D.O.M.)

Funding of operational expenses until 2038 (20 years), and seed-funding for exhibition

- **Industry:** Carl Zeiss AG
- **Foundation:** Carl-Zeiss-Stiftung
- **Foundation:** Ernst-Abbe-Stiftung
- **University:** Friedrich-Schiller-Universität Jena
- **Town/state:** Town of Jena

Carl Zeiss Stiftung

ZEISS

Ernst-Abbe-Stiftung

FRIEDRICH-SCHILLER-UNIVERSITÄT JENA

JENA LICHTSTADT.

Milestones in Optics from Jena

Enabled by close collaboration of (academic) research and industry

- 1801: discovery of **UV-radition**
- 1878: introducing commercial solutions for **homog. Immersion** in microscopy → enabling **bacteriology**
- 1911: inventing **single vision glasses** taking eye-movement into account → **in use by Billions**
- 1935: patenting **anti-reflection coatings** for optics → today‘s **standard** for **spectacles**
- 2020: Deutscher Zukunftspreis for **EUV-Lithography** → **basics** for today‘s **mobile phones**

USPs

- **Unique collection** of optical instruments (>> 40‘000 objects, comprising about 500‘000 items)
- approx. 1‘000 microscopes, many **milestones** of the **History of Science & Technology**
- 15‘000 **spectacles**
- 1‘400 images for the **Zograscope**
- Hundreds of graphics & paintings, starting in the 1600s

Expressionism: glass making

Passement, Paris 1751

Innovation Methods in Photonics
Challenges by D.O.M.

DEUTSCHES OPTISCHES MUSEUM

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DEUTSCHES OPTISCHES MUSEUM

Traget group(s)

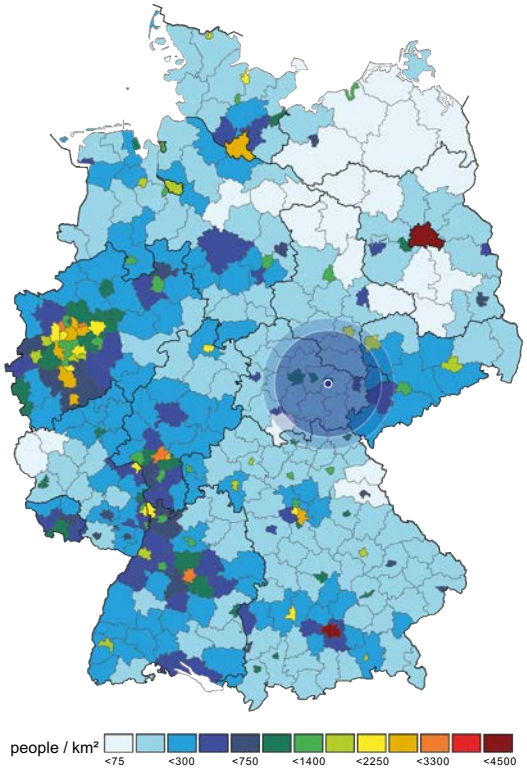
(1) Tourism / Marketing
Tourists for day-trips, travel groups, excursions

(2) Inhabitants and their private visitors
Families, single vistors

(3) Educational institutions
Schools, universities

(4) MICE & industry
Meetings, incentives, conferences and exhibitions for industry

(5) Scholars on the history of physics
Short-term and extended visits, research collaborations



DEUTSCHES OPTISCHES MUSEUM

Holistic grapsing of optics

Tell me *and I will* ***forget****.*
Show me *and I will* ***remember****.*
Let me do it *and I will* ***understand****.*

Konfuzius (551-479 BC)

1	**grapsing** optical effects (Science-Center approach with own experiments) attracting visitors with effects of daily life
2	**technical use** in (historical) instruments showcasing the **application** of the physical effects & **relevance** to **broaden knowledge**
3	**latest scientific results** → Showcase of research in optics and photonics

entire museum as **interactive exhibition**
approx. **2‘000 m²** exhibition (of 3‘100 m² accessible for visitors)

DEUTSCHES OPTISCHES MUSEUM

Treasure Chamber

(depot, glass archive, workshop)

Macro

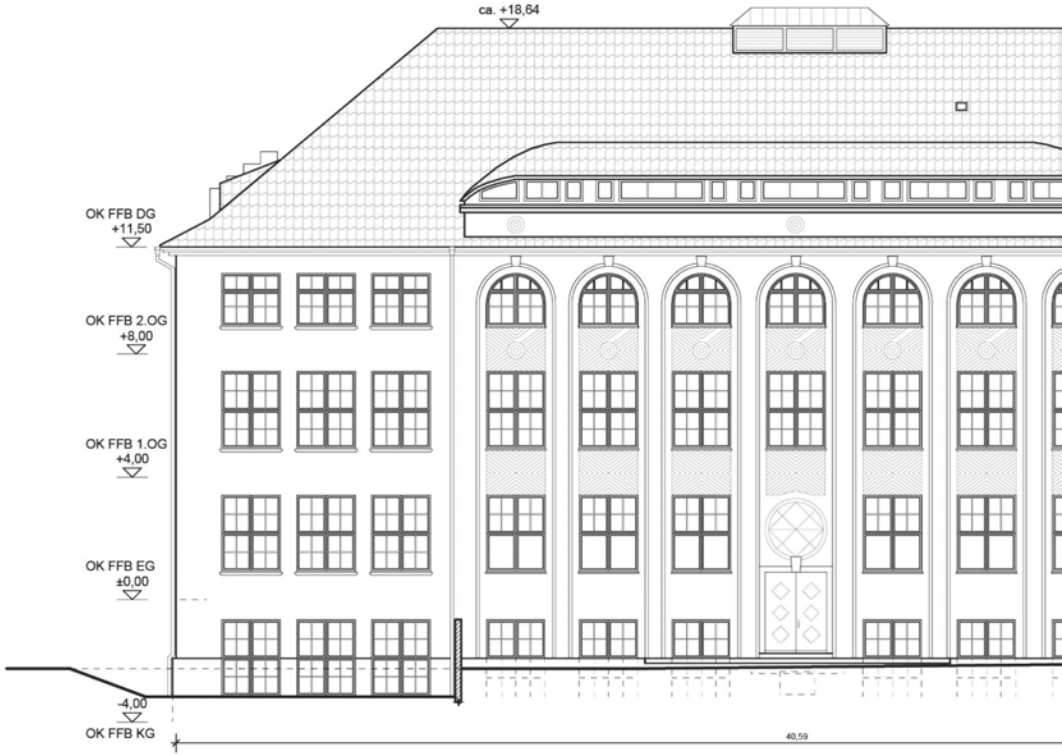
(the sun, astronomy, speed of light)

Meso

(the eye, spectacles, ophthalmology)

Micro

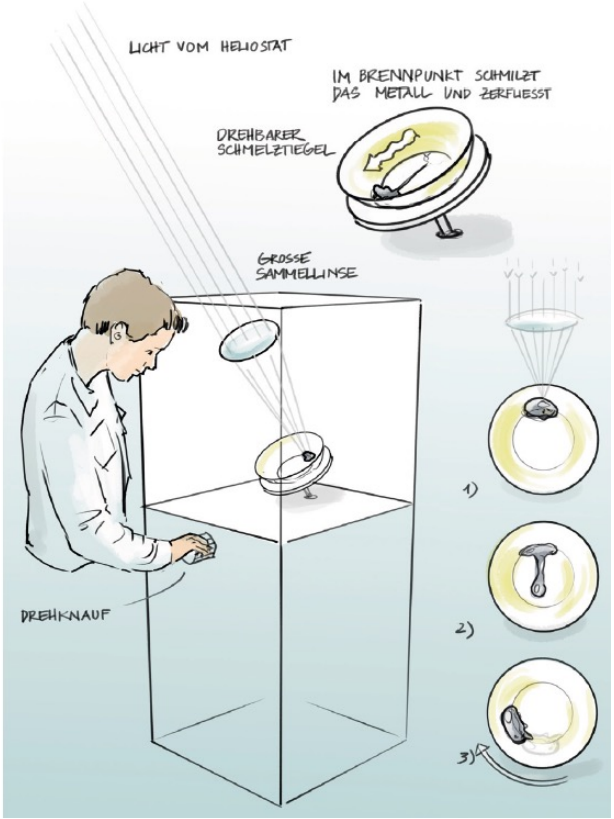
(microscopy, spectroscopy, interferometry)

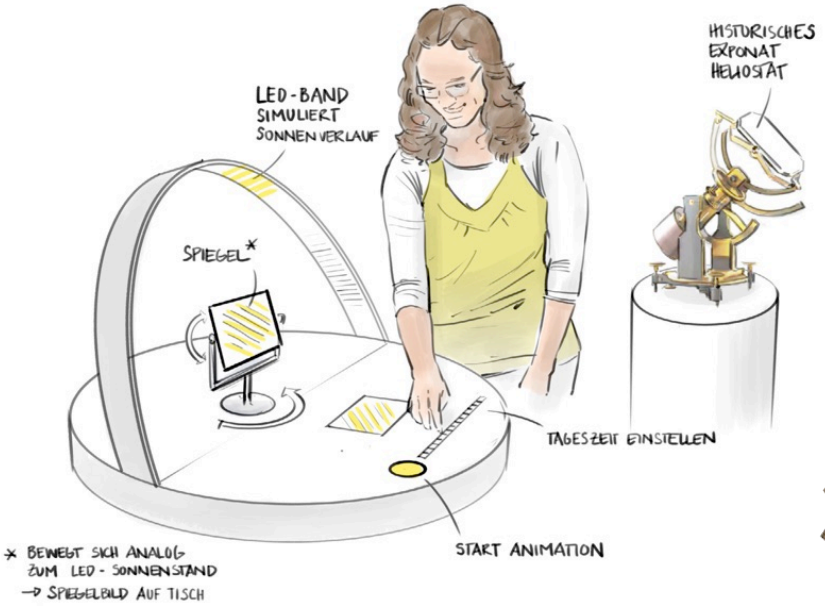


2 Exhibition

c. Example: Introduction room „Macro“

DEUTSCHES OPTISCHES MUSEUM



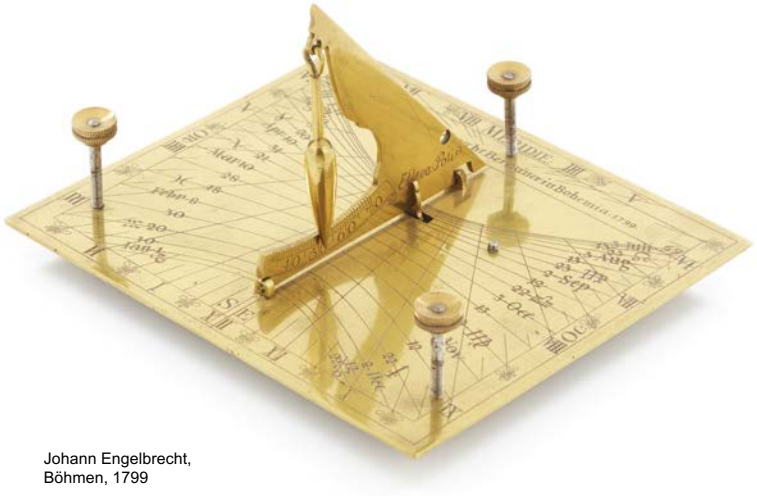


Duboscq
Paris, 1865

DEUTSCHES OPTISCHES MUSEUM

Sundials

- Working principle of sundials



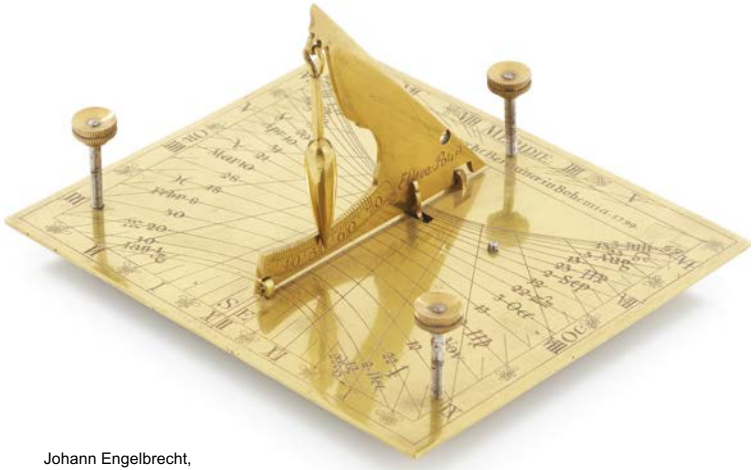
Johann Engelbrecht,
Böhmen, 1799

Unsigned
Germany, 1576

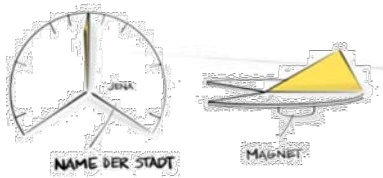
DEUTSCHES OPTISCHES MUSEUM

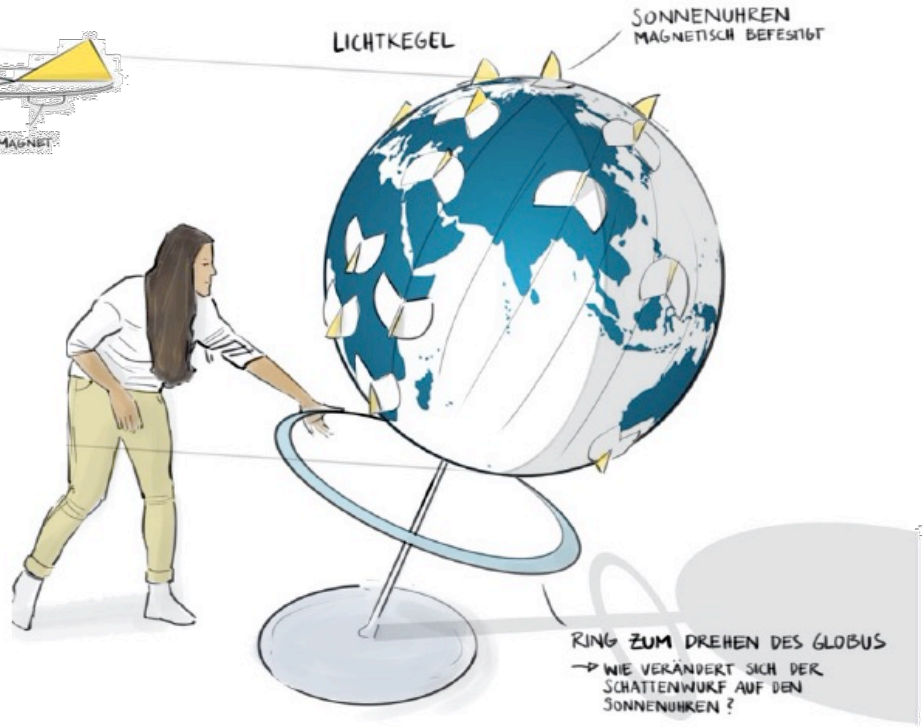
Sundials

- Working principle of sundials



Johann Engelbrecht,
Böhmen, 1799

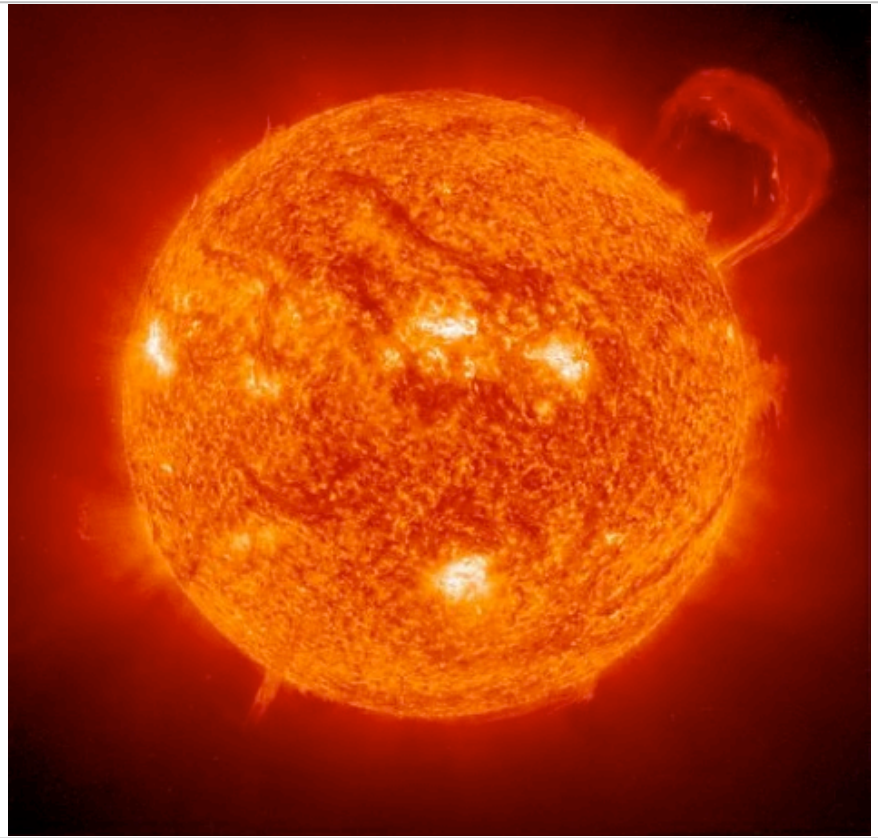




2 Exhibition

c. Example: Introduction room „Macro“

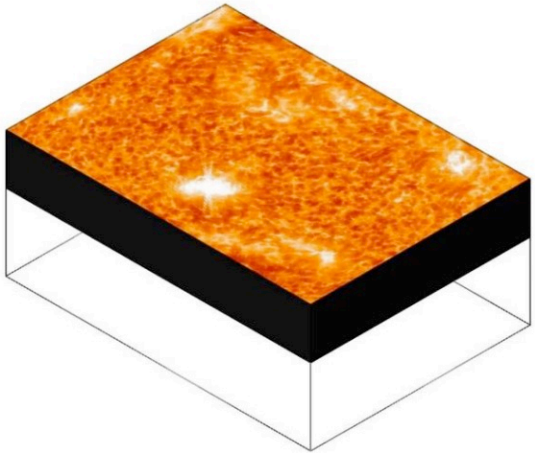
DEUTSCHES OPTISCHES MUSEUM

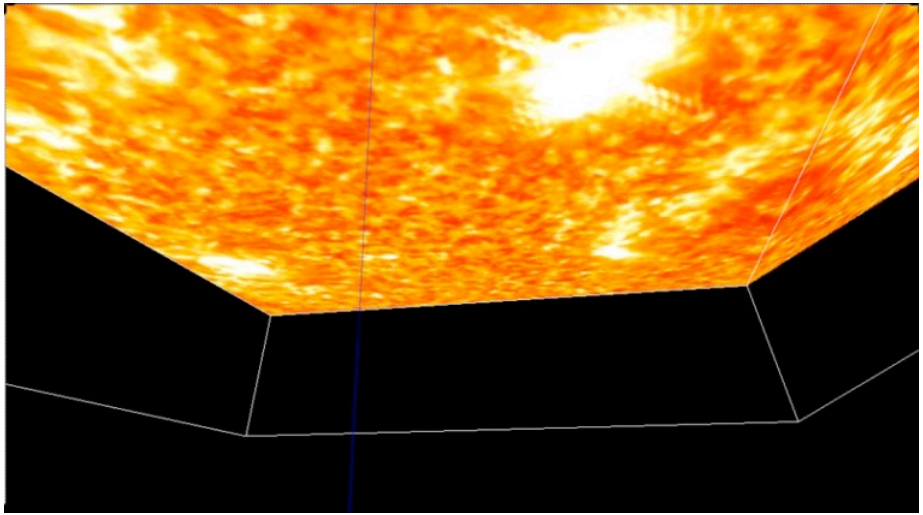


DEUTSCHES OPTISCHES MUSEUM

Display in the ceiling

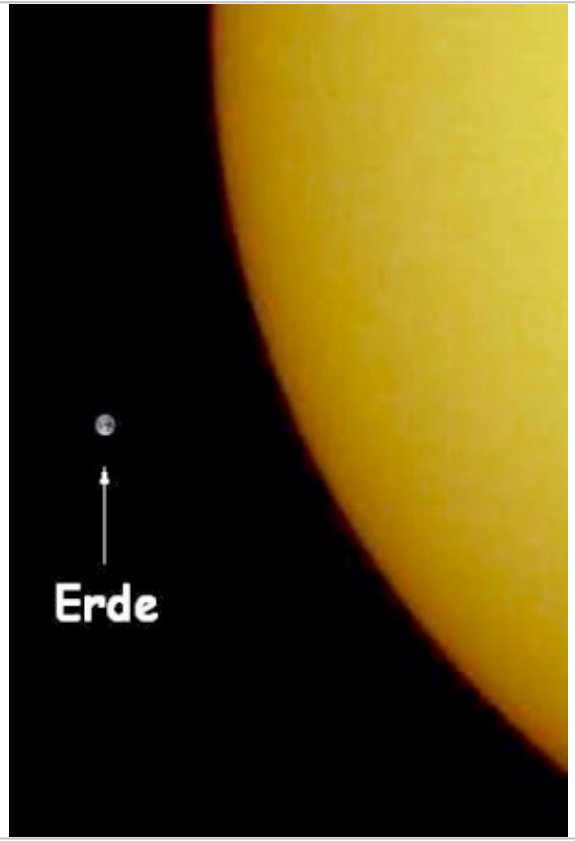
Satellite image of the sun as live-feed
Mirrors tilted to simulate the curvature of the sun.

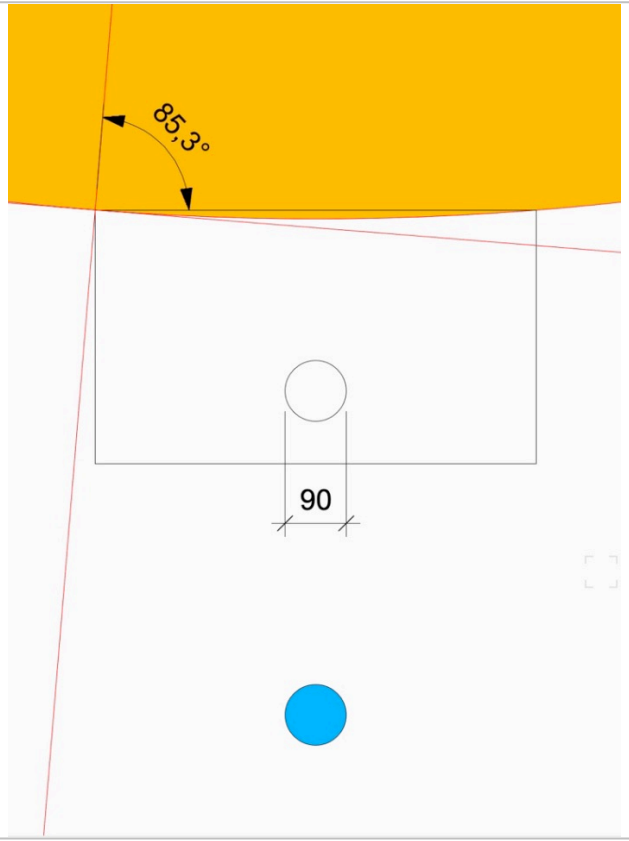


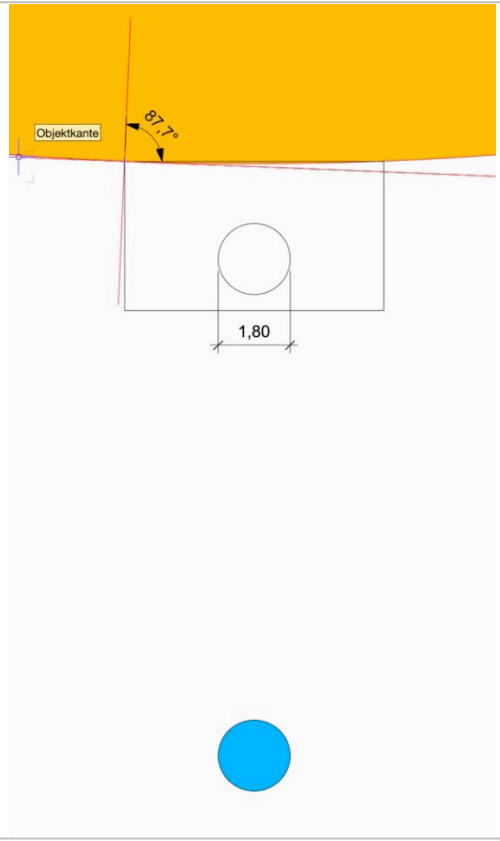


2 Exhibition

c. Example: Introduction room „Macro“







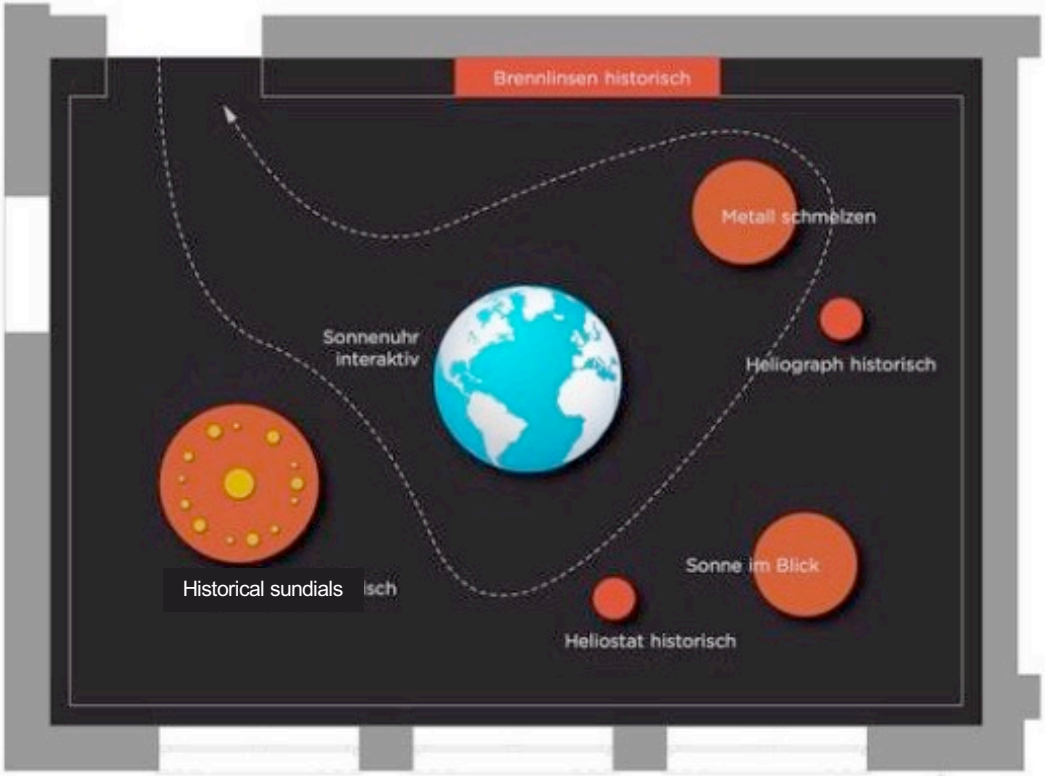
2 Exhibition

c. Example: Introduction room „Macro“

DEUTSCHES OPTISCHES MUSEUM

2 Exhibition

c. Example: Introduction room „Macro“

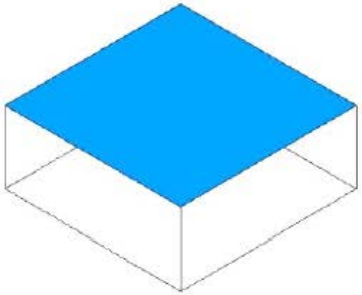


2 Exhibition

c. Example: Introduction room „Macro“

DEUTSCHES OPTISCHES MUSEUM

MAKRO



Innovation Methods in Photonics
Challenges by D.O.M.

DEUTSCHES OPTISCHES MUSEUM

3 Challenge 1: optically working eye model

DEUTSCHES OPTISCHES MUSEUM

Highlight for the introduction room MESO

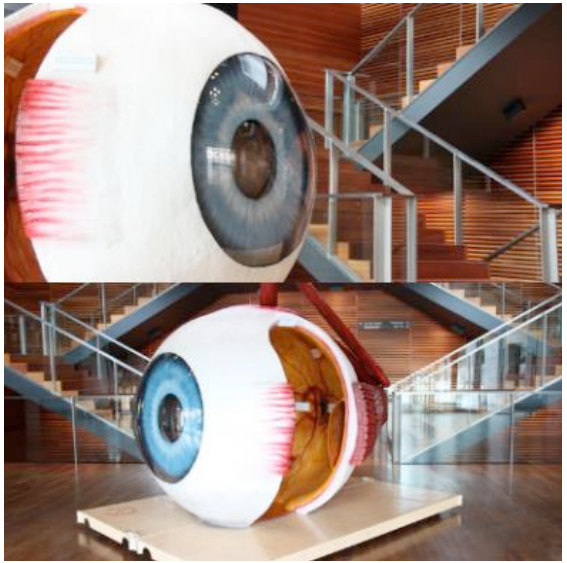
Explaining the function of the human eye. Key element shall be a giant eye, in which visitors can walk to experience the function of the human eye. Different to existing eye models, our model should be functionable and adaptive to actually see the projection of incoming light at the retina.

Challenge: Design an adaptable optically working eye model

- giant eye to work optically similar to a real eye.
- image by projection through the eye on the surface of the retina.
- continuously adapting the lens and iris of the eye to see capabilities and restrictions.
- vitreous body to be replaced by air → principle optical layout different to the human eye, as other refractive indices are required

Our expectations

- Find creative solutions, calculate and optimize them
- Design and build a prototype
- Have fun working in a team



https://www.organmodelle.de/augenmodell.html

3 Challenge 2: interactive macroscopic light-sheet microscope

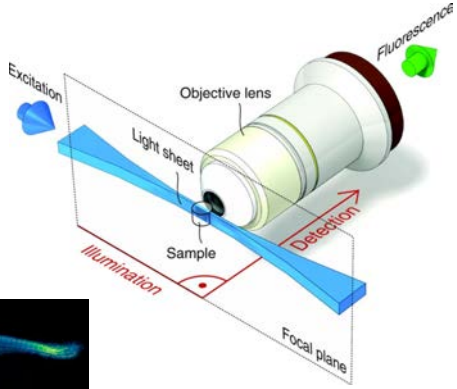
DEUTSCHES OPTISCHES MUSEUM

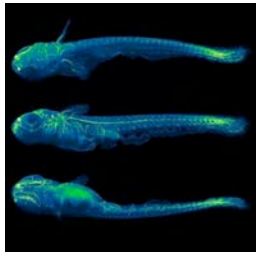
Highlight for the microscope methods room

There are 80 interactive setups. No black boxes with special effects or powerful abstract simulations, but real optics only, showing the working principle. For modern microscopy techniques, including ultra-microscopy, and different types of fluorescence microscopy there shall be a macroscopic light-sheet microscope.

Challenge: Build an interactive macroscopic light-sheet microscope

- Build a functionable macroscopic light-sheet microscope.
- macroscopic probe (e.g. the giant model of a Zebra Fish) to be fluorescent. Different layers of the probe have to be illuminated with a macroscopic light-sheet. The emitted fluorescence should be detected.
- 3D image shall be constructed and observed on a screen.
- Show the comparison with classic illumination of the whole sample





J. Huisken and DYR Stainier DYR (2009) The concept behind fluorescence light-sheet microscopy. Development 136:1963-1975

Our expectations

- Find creative solutions, calculate and optimize them
- Design and build a prototype
- Have fun working in a team

3 Challenge 3: water drop-based microscope

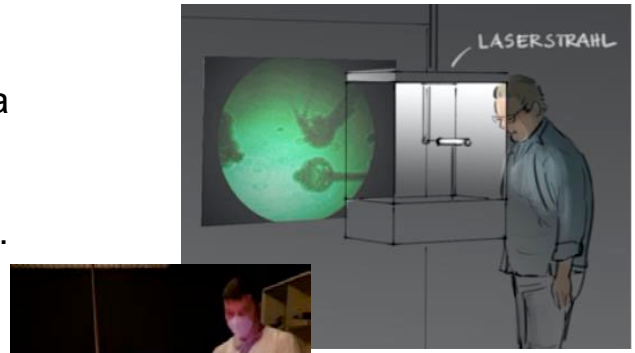
DEUTSCHES OPTISCHES MUSEUM

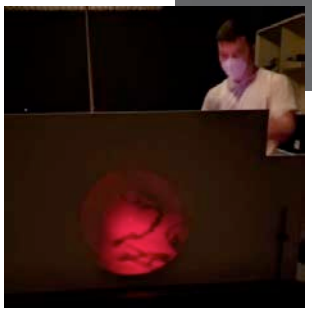
Highlight for the intro room of MICRO

Show that water drops can serve as magnifying lenses. The key element of this room should be a projection system which uses a dynamic water drop as main magnifying element. The visitor should learn that a water drop can serve as lens and that the magnification depends on the size and curvature of the drop.

Challenge: water drop-based microscope

- basic magnification setup by imaging pollution in pond water through a water drop while illuminating it with a collimated laser or a high-power white light source.
- Show a magnification of the sample at a white screen behind the drop. Calculate the system, use as few optical elements as possible
- Minimize speckles and other aberration errors
- Provide good photographic quality





J. Huisken and DYR Stainier DYR (2009) The concept behind fluorescence light-sheet microscopy. Development 136:1963-1975

Our expectations

- Find creative solutions, calculate and optimize them
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Innovation Methods in Photonics
Challenges by D.O.M.

DEUTSCHES OPTISCHES MUSEUM

1. Deutsches Optisches Museum (D.O.M.)
2. Exhibition
3. Challenge 1: optically working eye model
4. Challenge 2: interactive macroscopic light-sheet microscope
5. Challenge 3: water drop-based microscope

Build a prototype, which our design-bureau eventually will include to our new exhibition – and thus contribute directly to an item on display at D.O.M., which hundreds of thousands of visitors will interact with and learn from in the future.

4

DigiPhoton

Abbe School of Photonics | JENA
Friedrich-Schiller-Universität

Determination of Refractive Index with Remote Michelson Interferometer

LICHTWERKSTATT | JENA
OPEN PHOTONICS MAKERSPACE

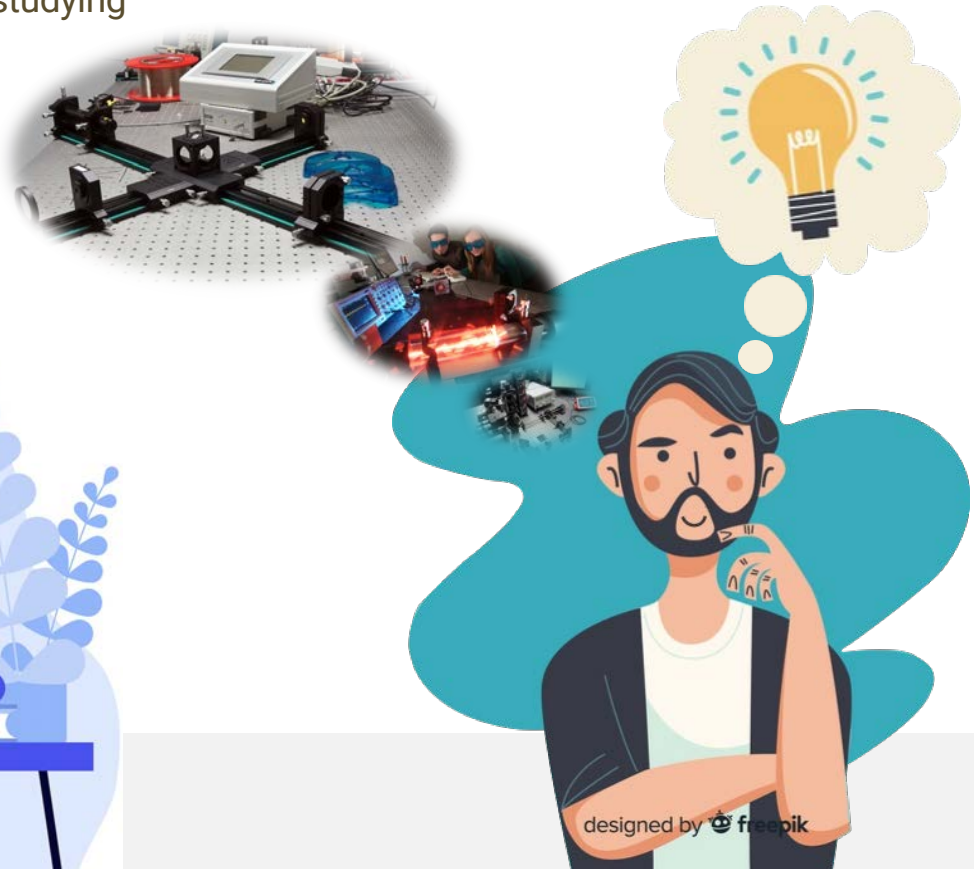
digiPHOTON

Mentors:
Nitish Jain (Abbe School of Photonics, FSU Jena)
Dipl.-Ing. Johannes Kretzschmar (Lichtwerkstatt, IAP FSU Jena)
Dr. Ilko Sojka (DigiPHOTON, IAP FSU Jena)

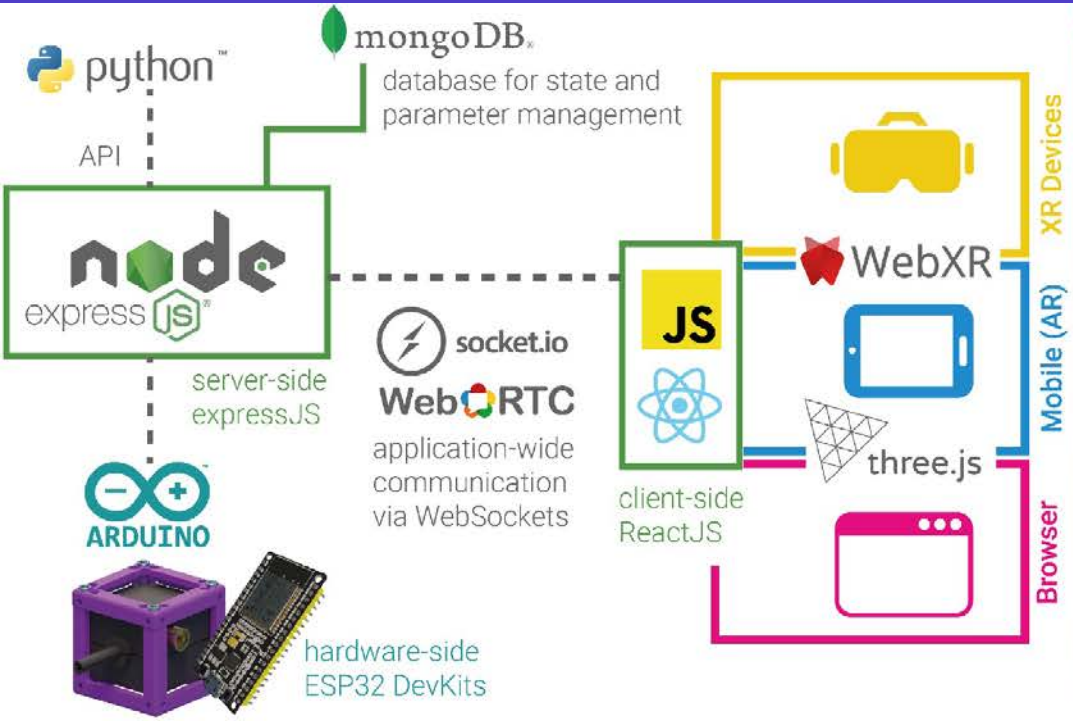
Contact:
Email: nitish.jain@uni-jena.de
LinkedIn: Nitish Jain
Instagram: herr_vaeen

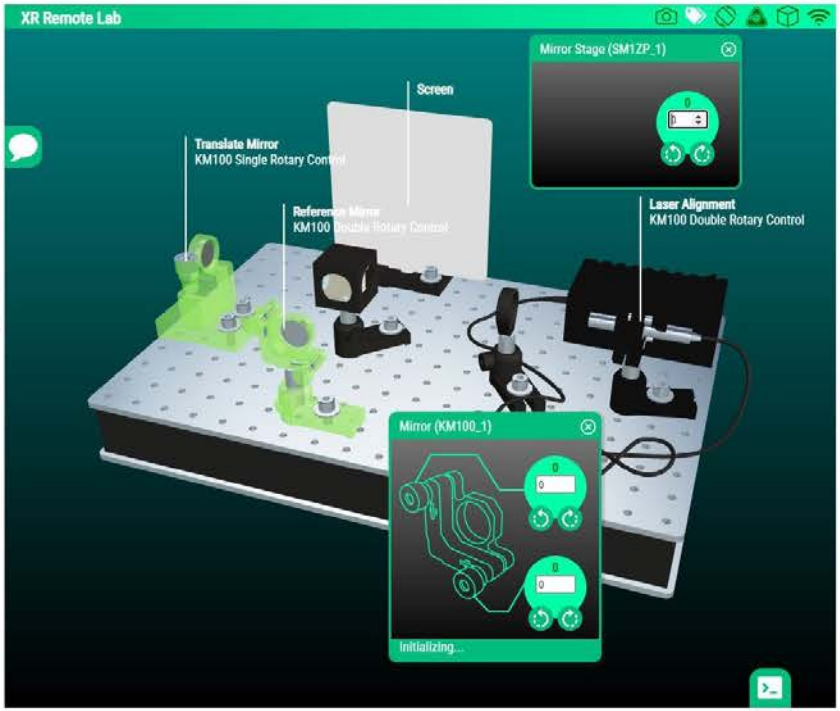
Remote Michelson Interferometer

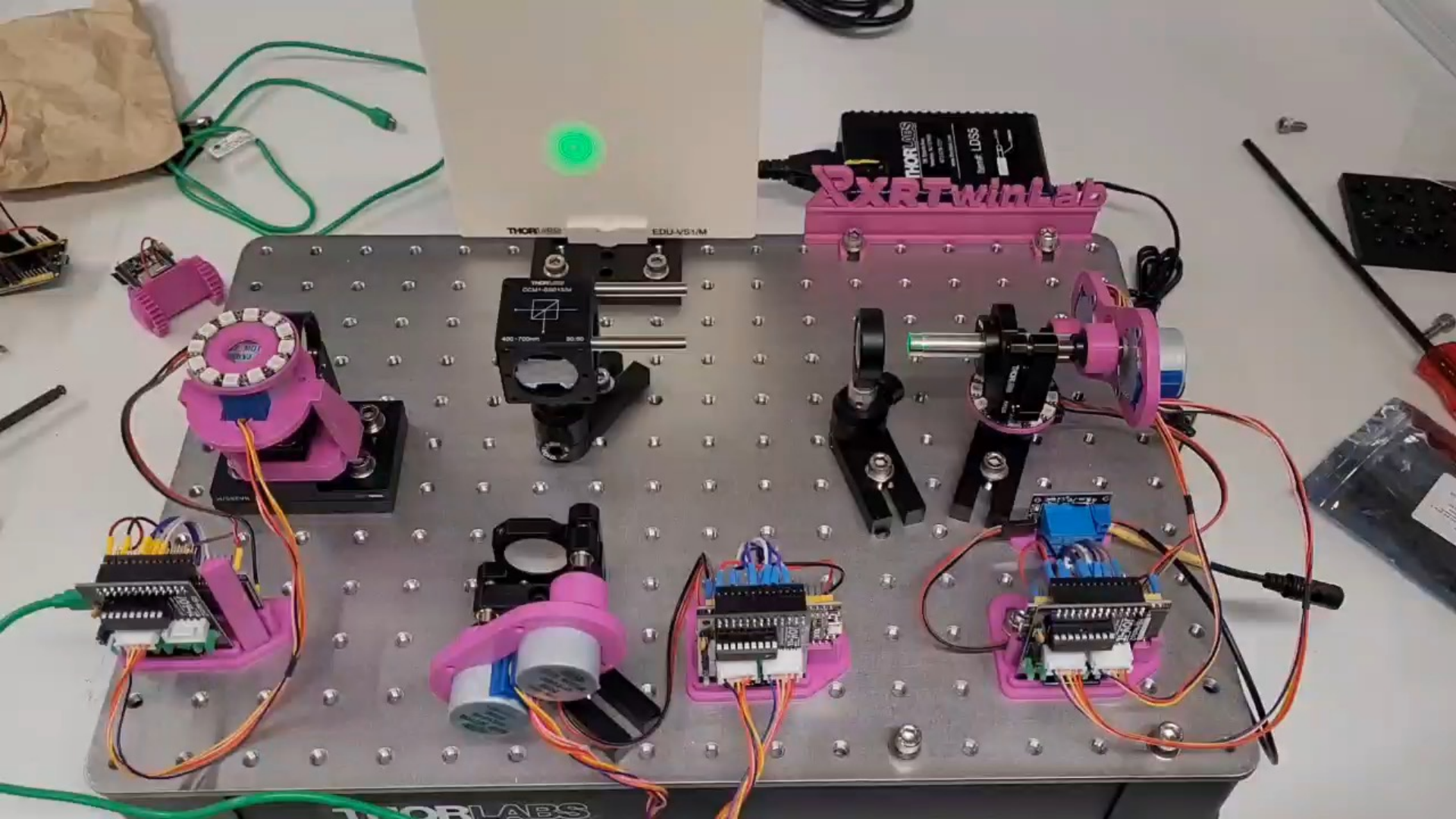
- **M.Sc. Photonics** should be available for remote studying
- Problem: lab courses are not possible
- Solution: **remote controllable experiments**



- First Prototype => Basic Michelson Interferometer
- Fully motorized and can be accessed via a web application
- Experimental results observable via a camera stream





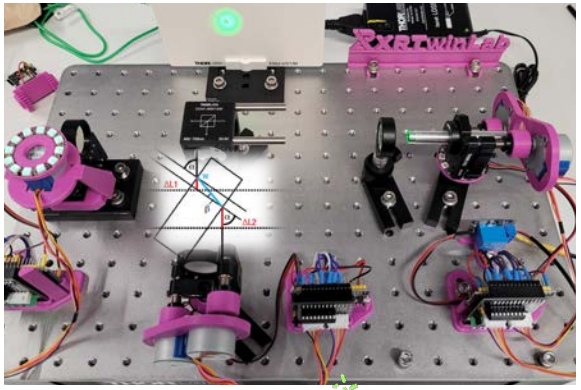

THORLABS
LDSS
EDU-VS1/M
XRTwinLab

Your task

digiPHOTON

LICHTWERKSTATT | JENA
OPEN PHOTONICS MAKERSPACE

- **extend** the currently existing setup with a refractive index determination
- **design** and **assemble** a platform to:
  - insert a sample into the interferometer arm
  - precisely rotate it to test variable optical path lengths
- **react** on messages from the XRTL (microcontroller, network)
- **digitalize** learning content



Contact:
Email: nitish.jain@uni-jena.de
LinkedIn: Nitish Jain
Instagram: herr_vaeen

FRIEDRICH-SCHILLER-UNIVERSITÄT JENA

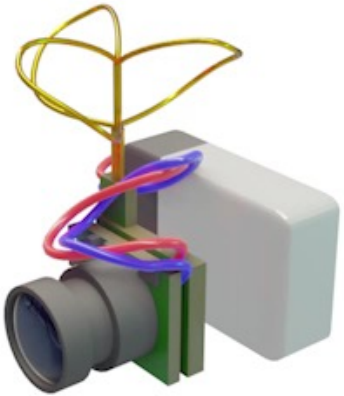
5

TwinLab OCR

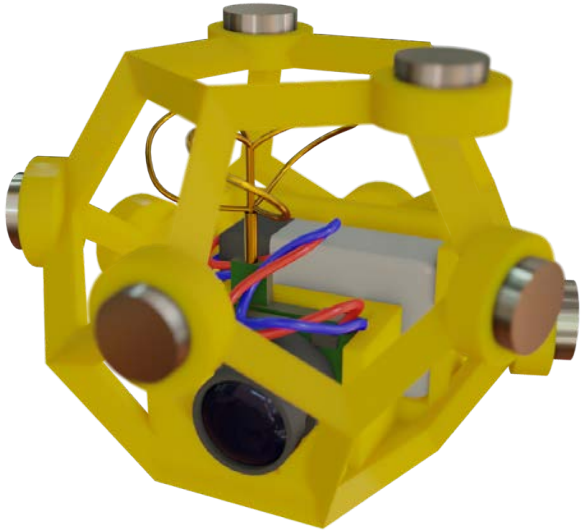
IMiP 2022
Integration of Measurement Devices into Digital Twin of Lab Experiments

Dipl.-Inf. Johannes Kretzschmar
johannes.kretzschmar@uni-jena.de
03641 / 9-47577
ACP 201

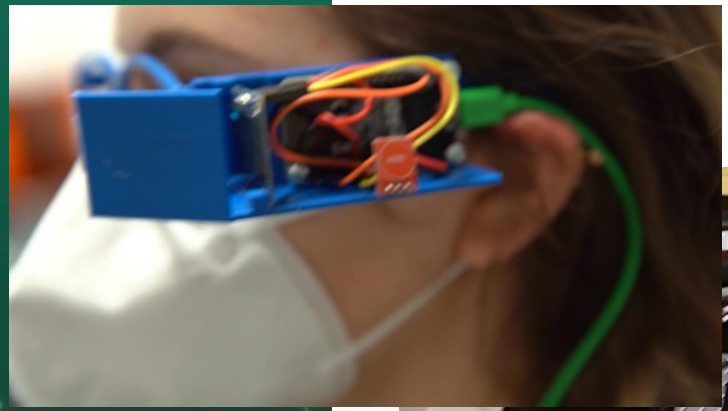
Challenge Background: DodeCam (2020)

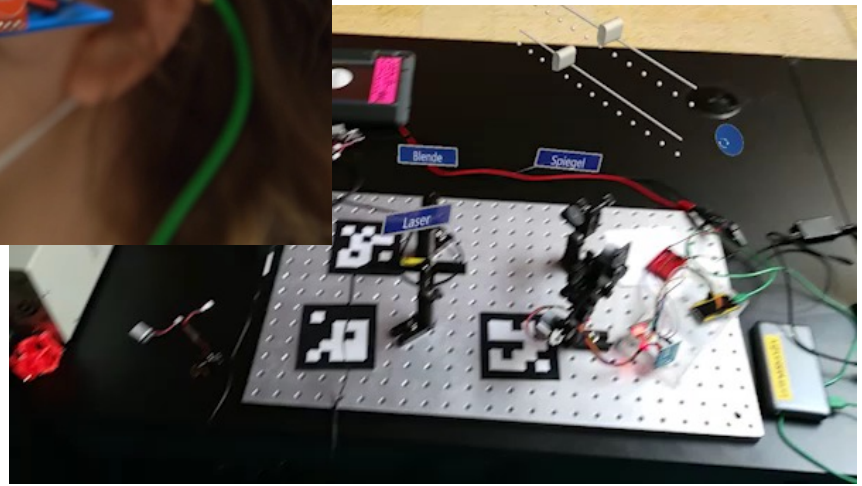


Challenge Background: DodeCam (2020)



Challenge Background: IoT Lab (MQTT)





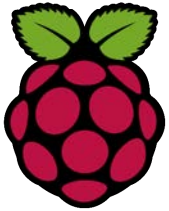
Challenge

Possible Interfaces for Devices

- Display
- Panel (LEDs, Indicators)
- Analog Outputs
- Digital Outputs
- LAN
- WiFi
- Bluetooth
- Software Interface

Challenge

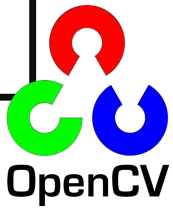
Human-Centered Measurement Device



NVIDIA JETSON

Embedded Device (OCR)

Cam



OpenCV

Data

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{value:0.387}
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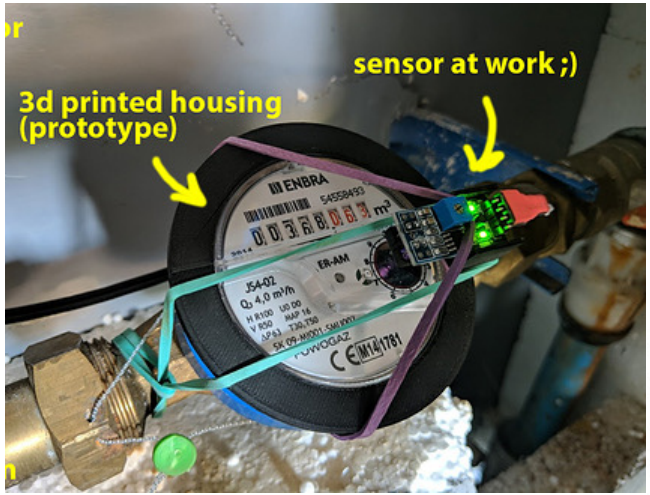
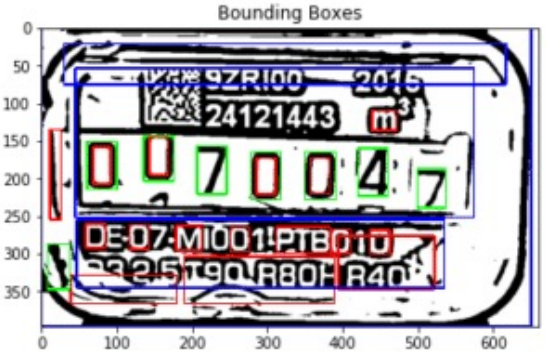
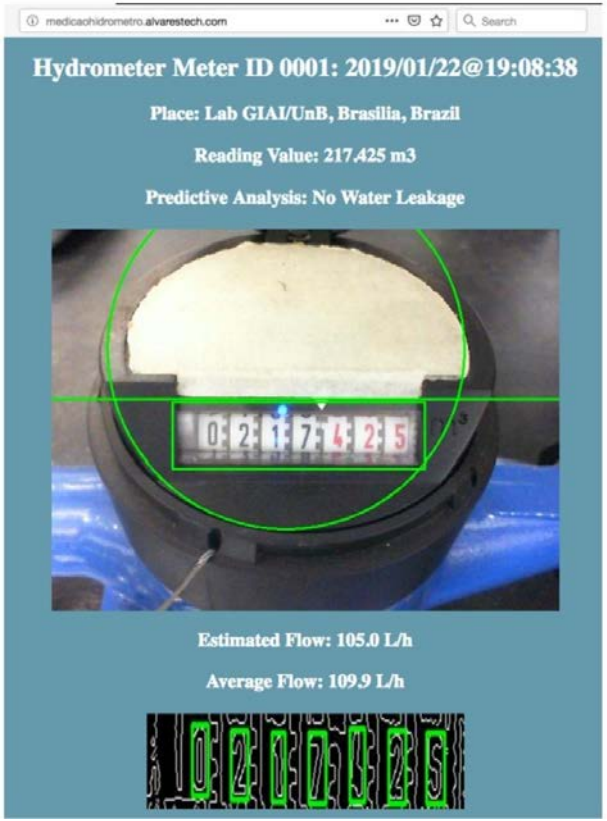
Existing Projects







Challenge Wrapup

- Investigate about usual measurement devices and their user interfaces
- Implement an OCR algorithm based on an interface
- Set up embedded hardware device to run camera and algorithm
- Develop ways to configure the device to various interfaces
- Design and implement case with versatile positioning mechanism

Recommended Skills and Interests

- Machine Learning (Python, OpenCV, PyTorch or similar)
- Mechanial Engineering

6
Lastronics

LASTRONICS

DIODE LASER PUMP MODULES · PUMP ENGINES · DRIVERS

Challenge: Build a beam homogenization using (partially) coherent light sources

What we are looking for

Lastronics (LTX) is specialized in the development, manufacturing and sale of laser diode technology with high peak power and associated power supplies, controls and accessories as part of large laser systems. Recently, Lastronics also offers the manufacturing of diode pumped, high-power solid state laser amplifiers based on Yb^{3+}-doped materials.

The diode laser systems are widely used for optical pumping of high power solid state laser systems, but also for direct laser-material interaction with relatively long interaction time (milliseconds). Laser amplifiers offer shorter pulse durations (fs to ns), but they are fully coherent light sources with high demands on the surface accuracy of the optical elements used.

The question we ask is: How can we unite the best of both worlds?

Background

Phase plates are widely used in conjunction with coherent laser sources in order to produce elaborate amplitude patterns in an image plane. However, high quality specifications in the image plane can only be met if the wavefront of the laser can be controlled to similarly high standards. A more robust procedure involves the use of so-called micro lens arrays (MLAs). Their basic design can be looked up in figure 1 below.

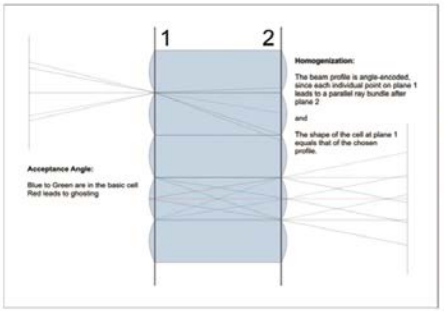


Figure 1

Motivation of the design parameters of microlens arrays:

All beams outside of the acceptance angle lead to ghost images in the image plane.

For the used design (focal lengths are equal in plane 1 and 2), acceptance angle and imaging angle are equal.

LASTRONICS

DIODE LASER PUMP MODULES · PUMP ENGINES · DRIVERS

With coherent light sources the use of MLAs as in figure 1 leads to the following problems:

1. Since plane 2 lies within the focal distance of the lenses in plane 1 for the chosen design, no homogenization will occur for collimated beams. The beam will be focused on the second lens instead which has no optical effect on the beam other than changing the divergence of the outgoing beam.

2. A converging or diverging beam leads to an optical effect of the lens array in plane 2, however, the beam will be very small on the second surface leading to an overemphasis on MLA surface deformation, or to a violation of the acceptance angle.

3. Both another MLA in front of the pair and a customized MLA pair can solve these geometrical optics problems. However, destructive interference for surface deviations in the range of one third to two wavelengths lead to a fast breakdown of the homogeneity of the beam profile in the image plane.

A suggested solution is the use of different transmissive scattering surfaces in front of the MLA. Scattering angles should be measured and adapted to the acceptance angle of the MLA, which can be accomplished by using telescopes and/or by producing an appropriately micro-structured surface (scattering disc) with the right scattering angles.

Your Task

While the homogenization of partially coherent light sources using micro lens arrays (MLA) is already widely used in LTX products, we have yet to modify the beam of fully coherent sources like solid state lasers, such that phase interference effects become negligible for them to be used in conjunction with MLA instead of phase plates. Your challenge will be to search for a consistent solution of that problem.

Our expectations

- Try and optimize optical setups!
- Use mechanical tools to change optical surfaces of substrates!
- Find creative solutions for the problem of intentional de-coherence!
- Design and build a prototype which helps to prove the concept!
- Have fun working in a team!

Mentor

Dr. Ragnar Bödefeld, Lastronics Jena, rb@lastronics.com

7

OQmented


OQMENTED
WE SCAN LIGHT
Contributing to „Innovation Methods in Photonics“
by Lichtwerktatt Jena / Summer 2022

OQMENTED / Who we are

Company

- Deep-Tech-startup
- Spin-Off from Fraunhofer Institute ISIT in Itzehohe / Schleswig-Holstein
- Offices in Itzehoes, Kiel, Essen, Jena, Palo Alto
- 50+ employee and growing

Product : MEMS-mirrors

- Scannning ligth beams 1D or 2D
- Mirrors running on there natural frequency (not step by step)
- Mirror diameters: 0,3 mm .. 10 mm
- Deflection angels up to 180°
- scanning frequenzies up to some 10th kHz

but not all maximum values in one device

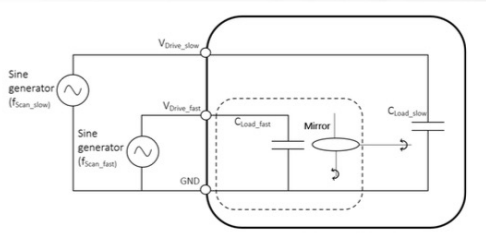
Targeted Fields of Application

- AR glasses (miniatur image projection)
- 3D scanning (miniatiur AR sensing)
- LIDAR (automotive sensing)

The Task : Project something usefull

Material offered:

- DevKit 1D
  - Mirror: ellyptical 2mm x 4mm
  - FoV 176°
  - Scanfrequencies 1,5kHz



- DevKit 2D
  - Mirror circular D 5,5mm
  - FoV 20°x20°
  - Scanfrequencies 2,4kHz / 2,1kHz

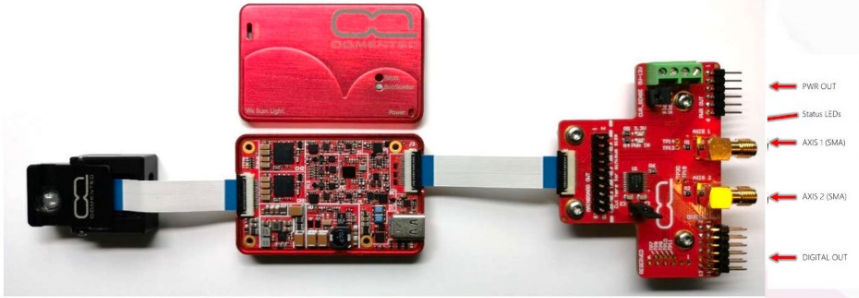
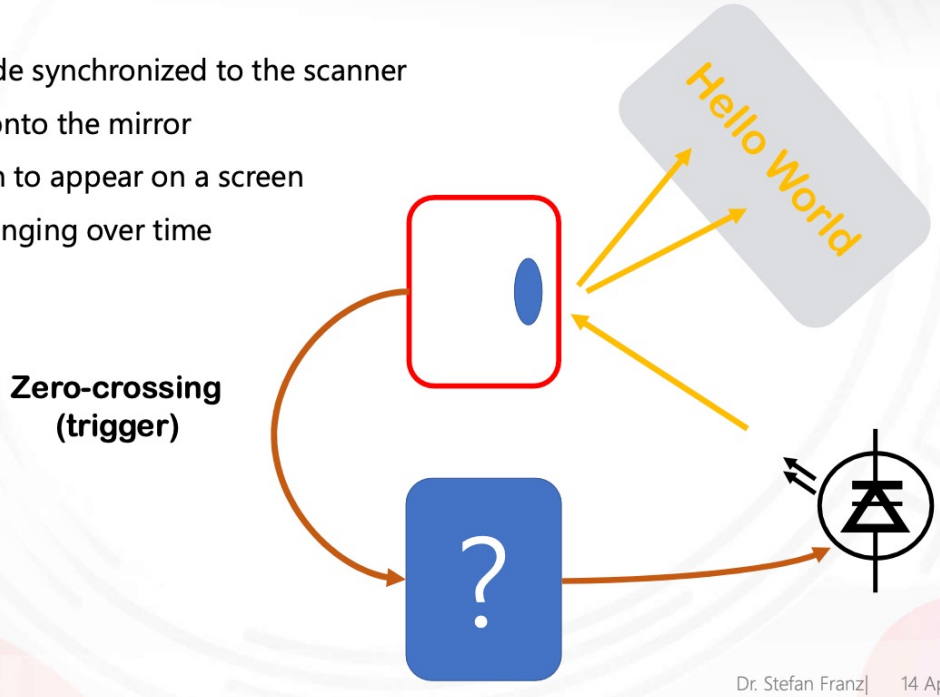


Figure 1: MEMS scanning mirror module (left), MEMS mainboard (middle) and adapter PCB (right)

The Task : Project something usefull

Technical Task:

- modulate a laser diode synchronized to the scanner
- point the laser ligth onto the mirror
- make a stable pattern to appear on a screen
- make the pattern changing over time



The Task : Project something usefull

Application Idea „Semi-circular Ticker“:

- use some (8) laserdiodes
- point them with a sligth angle to each other onto the 1D-scanner
- use a zylindrical surface as a screen
- let some text run along the screen
- optional limitation: use the bildspace inside the zylindrical screen only -> create the modul steckable to an advertising pillar

8

IMMS | MAQUERSPACE

IMiP 2022
DIY Single Photon Detector with Active Quenching

Dr. Falk Eilenberger (IAP Jena, MPSP)
Dipl.-Ing Michael Meister (IMMS)
Jakob Hampel (IMMS)
Dipl.-Inf. Johannes Kretzschmar

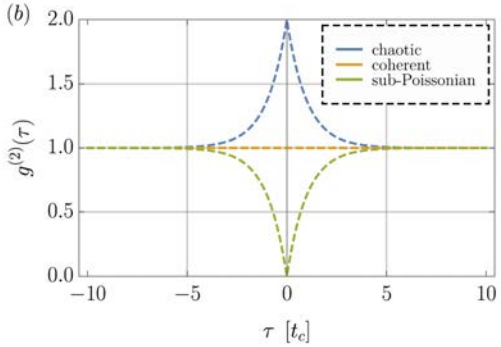
MAKERSPACE | JENA
QUANTUM PHOTONICS FOR ALL

IMMS

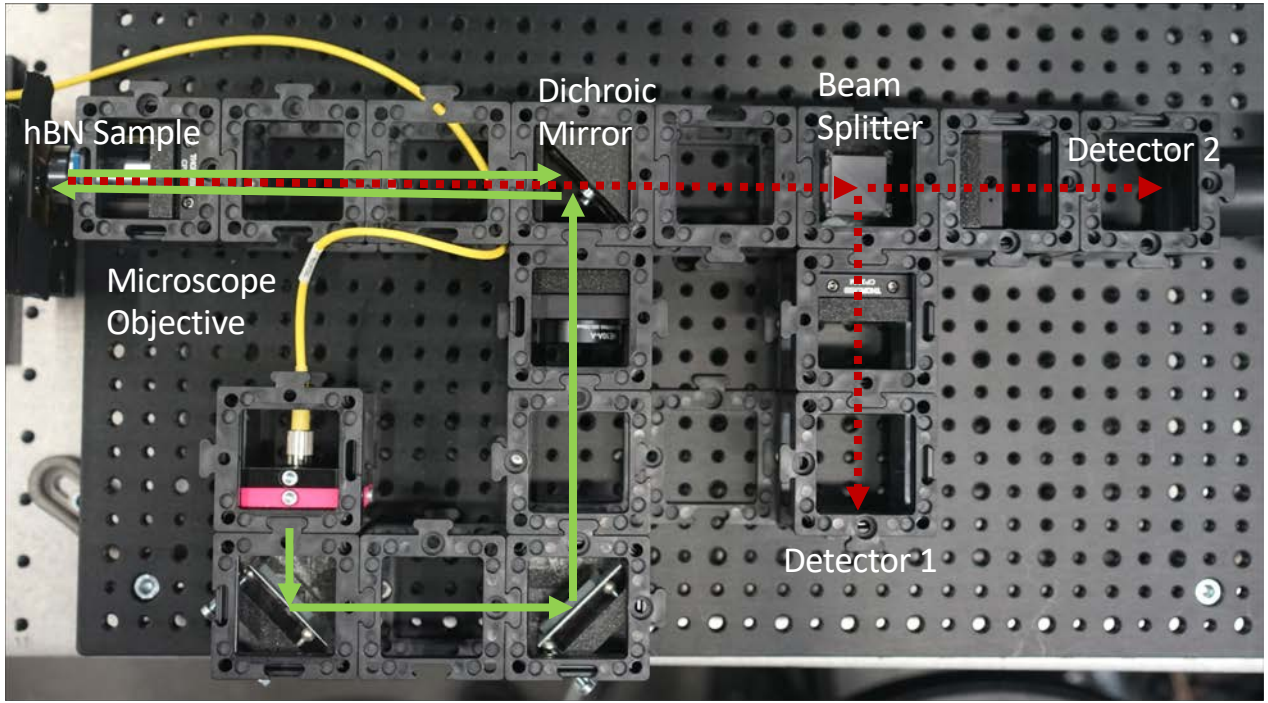
Maquerspace Project

Canonical Experiment: Hanbury-Brown-Twiss Interferometer

MAQUERSPACE | JENA
QUANTUM PHOTONICS FOR ALL



UC2 Setup of a HBTI

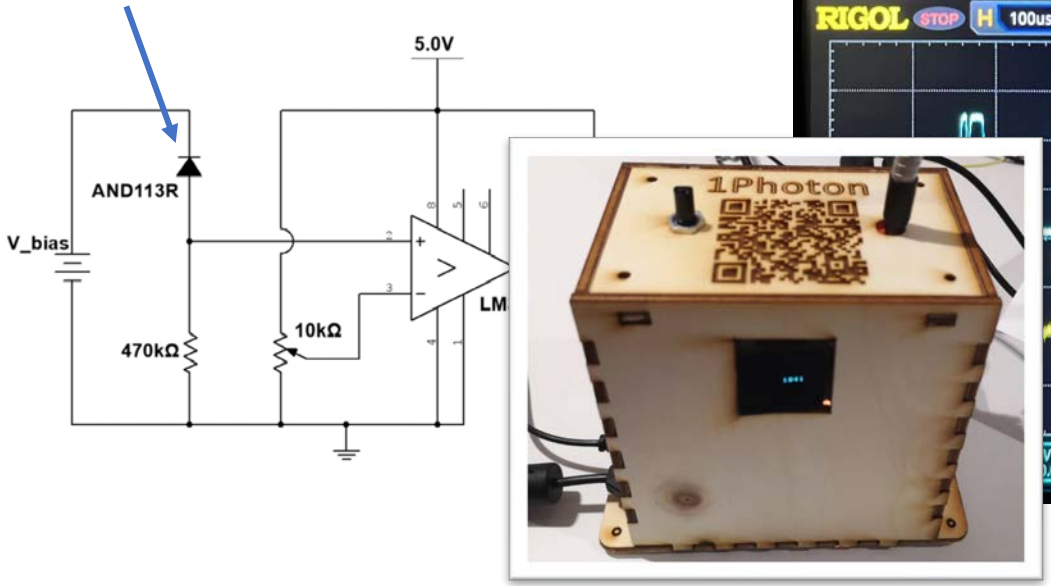


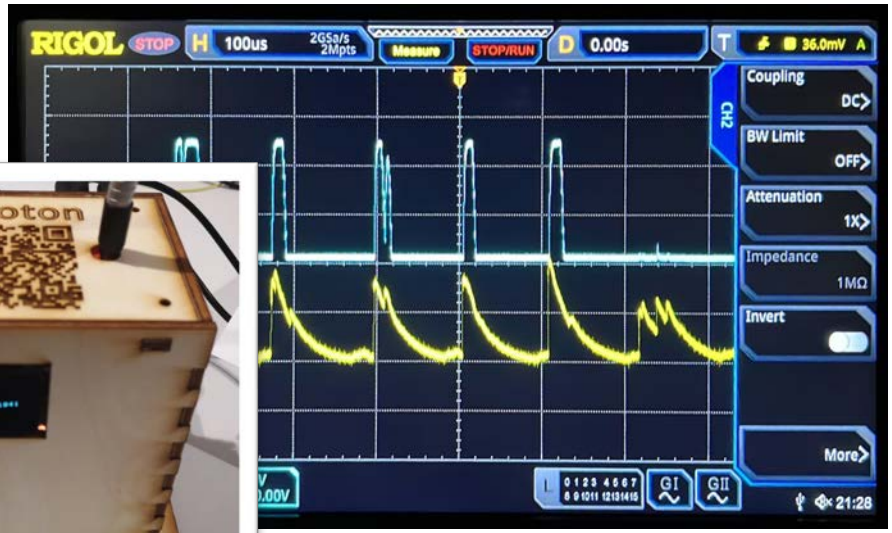
YOU. SEE. TOO.

Material Costs	
Mirrors	60 €
Filters	270 €
Beam Splitter	130 €
Objective	400 €
Mounting (10 Cubes)	50 €
Lenses	70 €
Sum	**980 €**

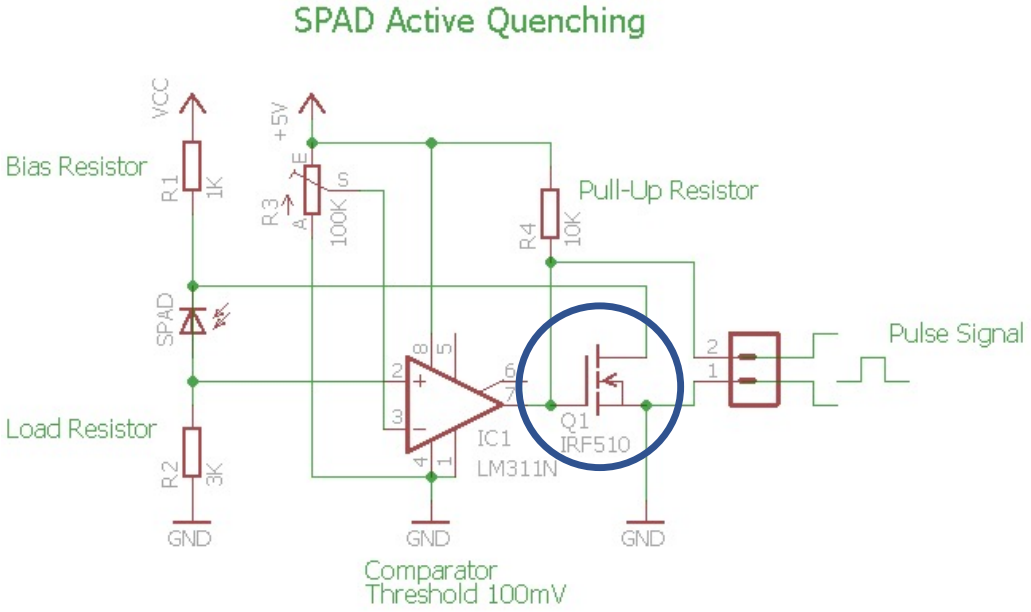
Current State of DIY SPAD (IMiP 2021)

DIY Single Photon Avalanche Detector
based in LED

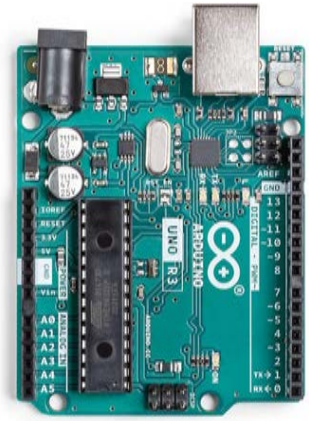


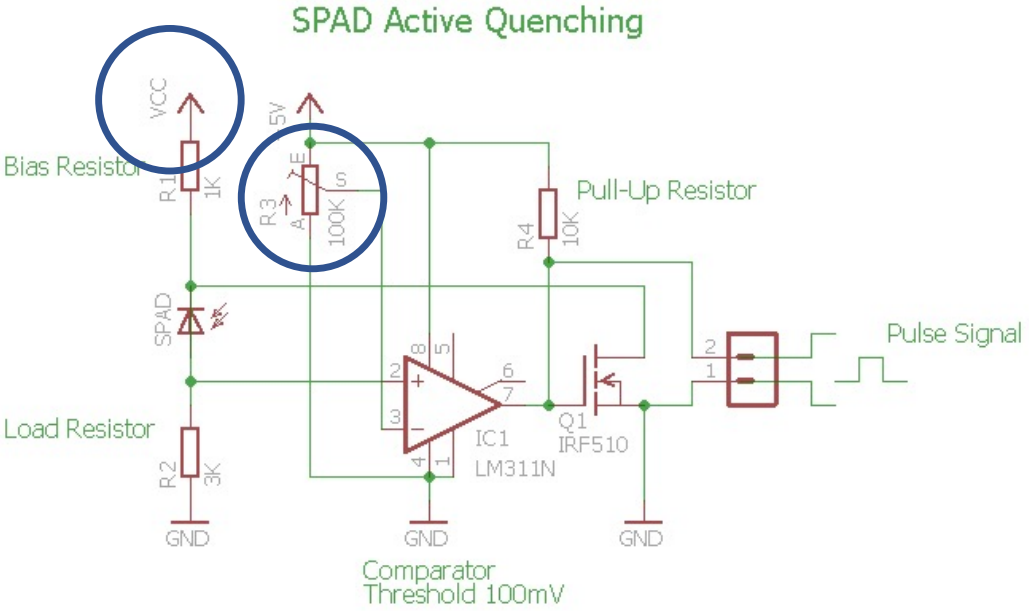


Challenge: Active Quenching

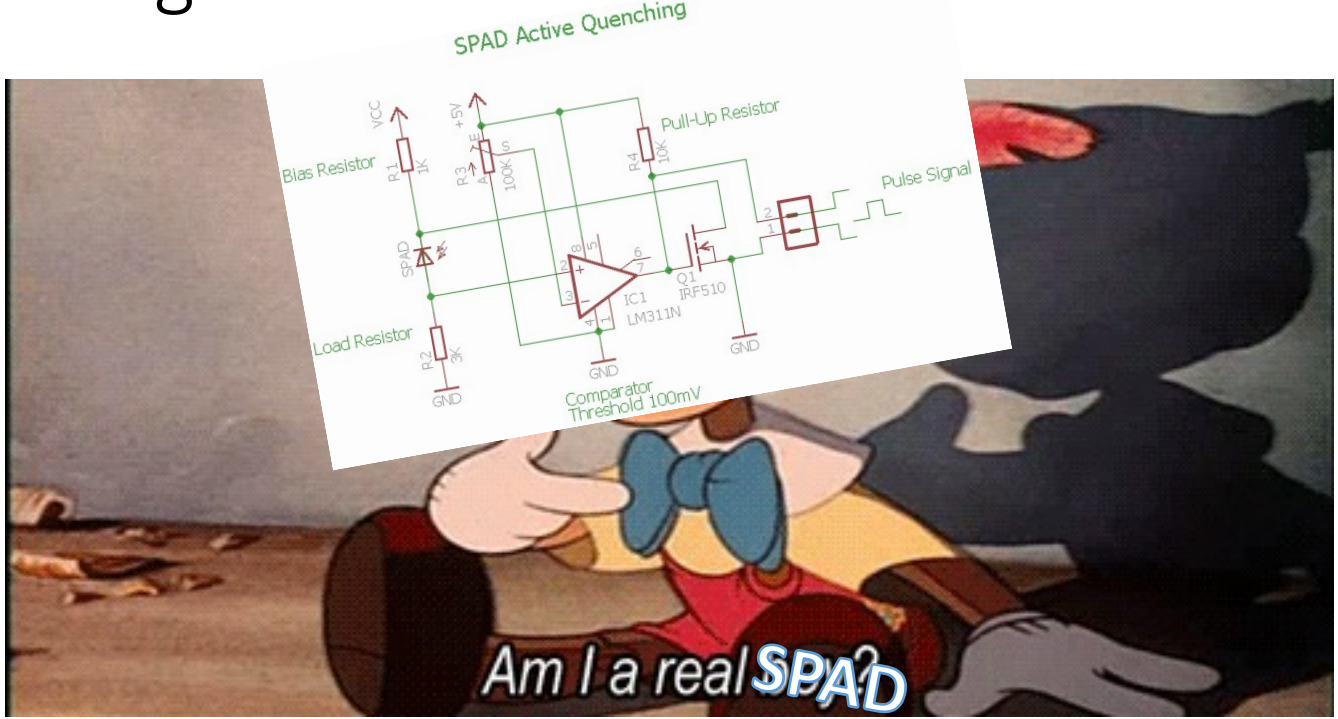


Challenge: Finetuning Controls

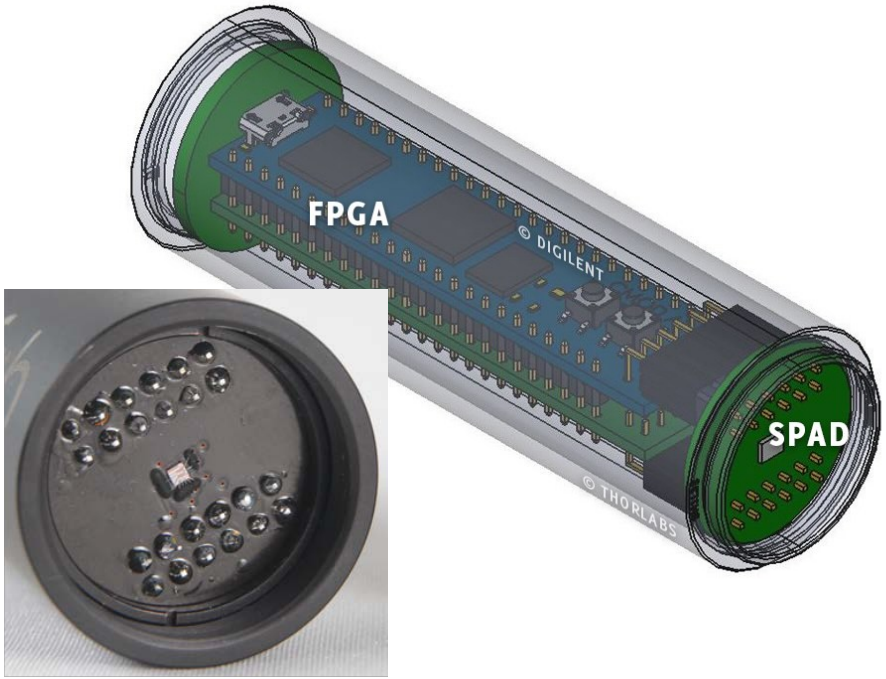




Challenge: Towards a real SPAD



Mentors: IMMS



- Integrated SPAD and Quenching Circuit
- Low sensitivity and medium dark count rate with very low dead time
- Possibility of SPAD arrays
- Added FPGA timing electronics possible
- Mounted in SM1 lens tube
- Not open-source

Quantum Hub Thüringen

Challenge Wrapup

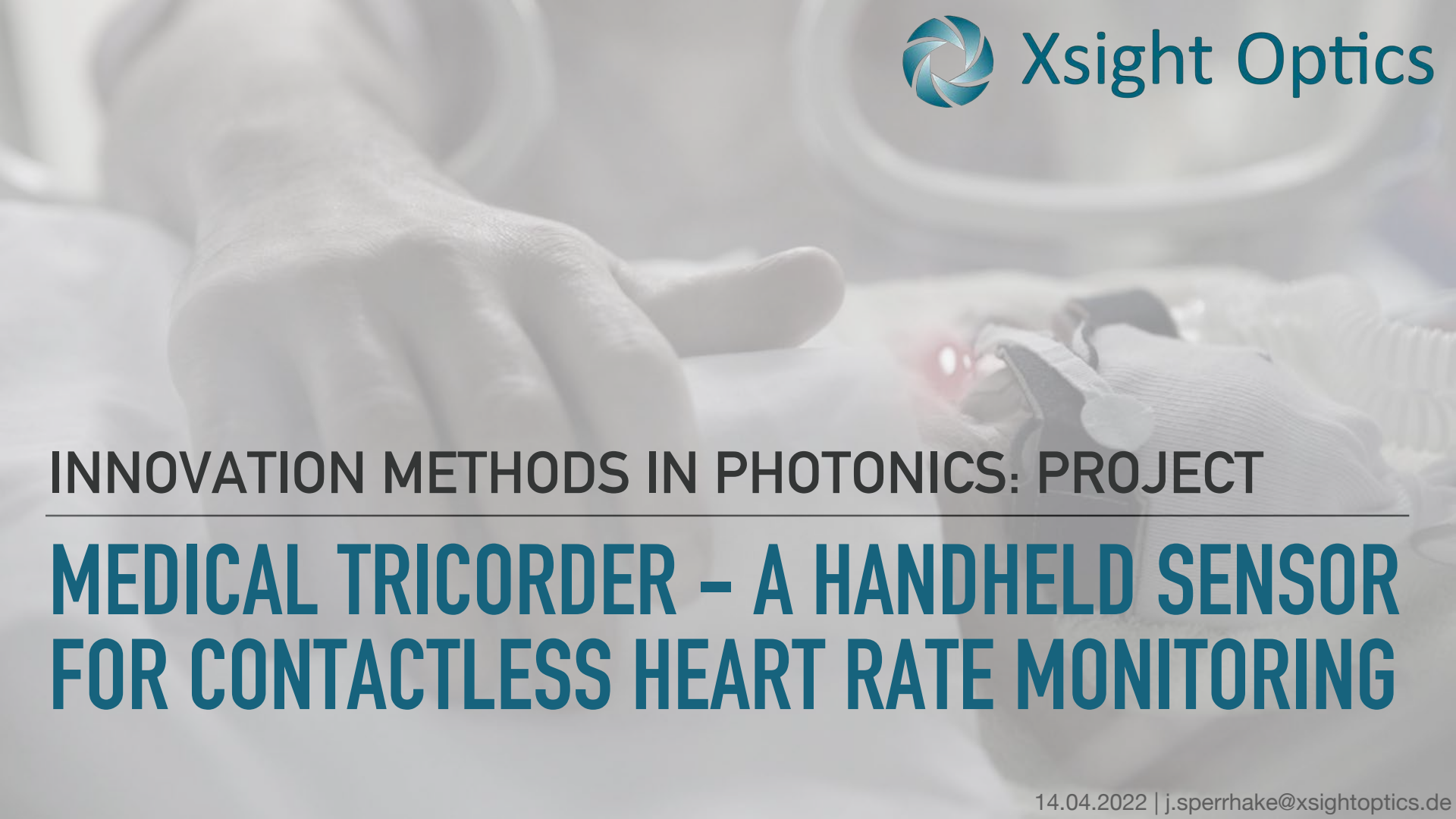
- Extend the SPAD circuit to active quenching
- Build boost converter for bias voltage of SPAD LED
- Implement microcontroller to optimize control and fine tuning
- Test and evaluate characteristics (DCR, Jitter, PDP)

Recommended Skills and Interests

- Electrical Engineering
- Hardware Programming

9

Xsight Optics



Xsight Optics

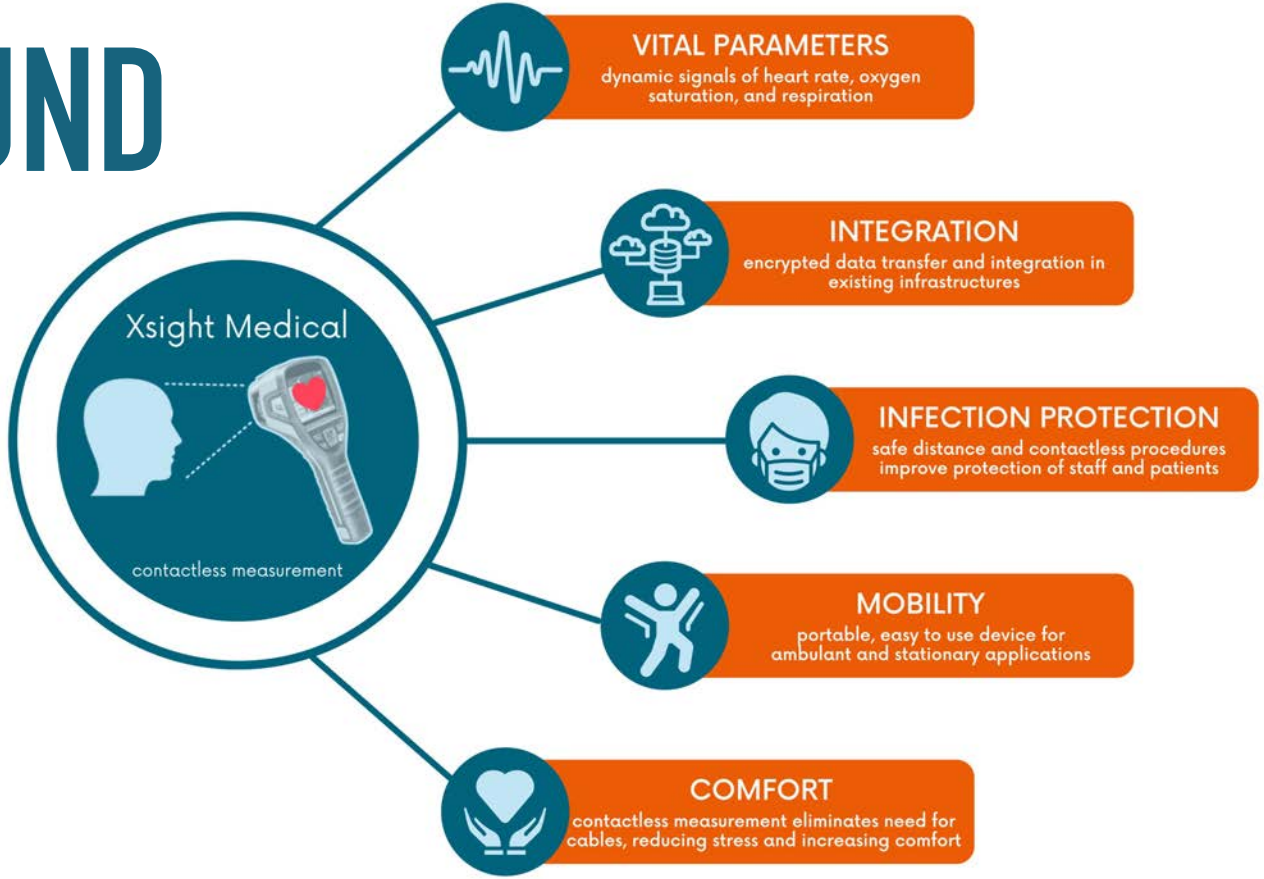
INNOVATION METHODS IN PHOTONICS: PROJECT

MEDICAL TRICORDER – A HANDHELD SENSOR FOR CONTACTLESS HEART RATE MONITORING

14.04.2022 | j.sperrhake@xsightoptics.de

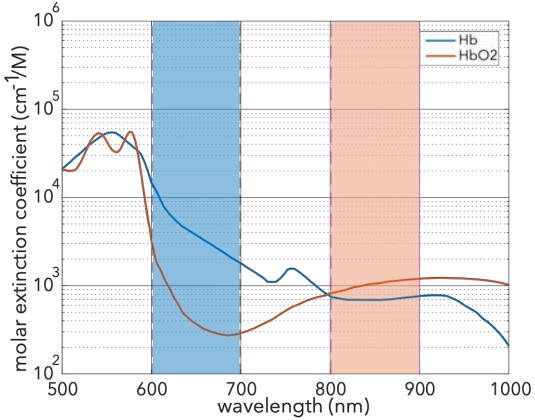
BACKGROUND

healthcare crisis

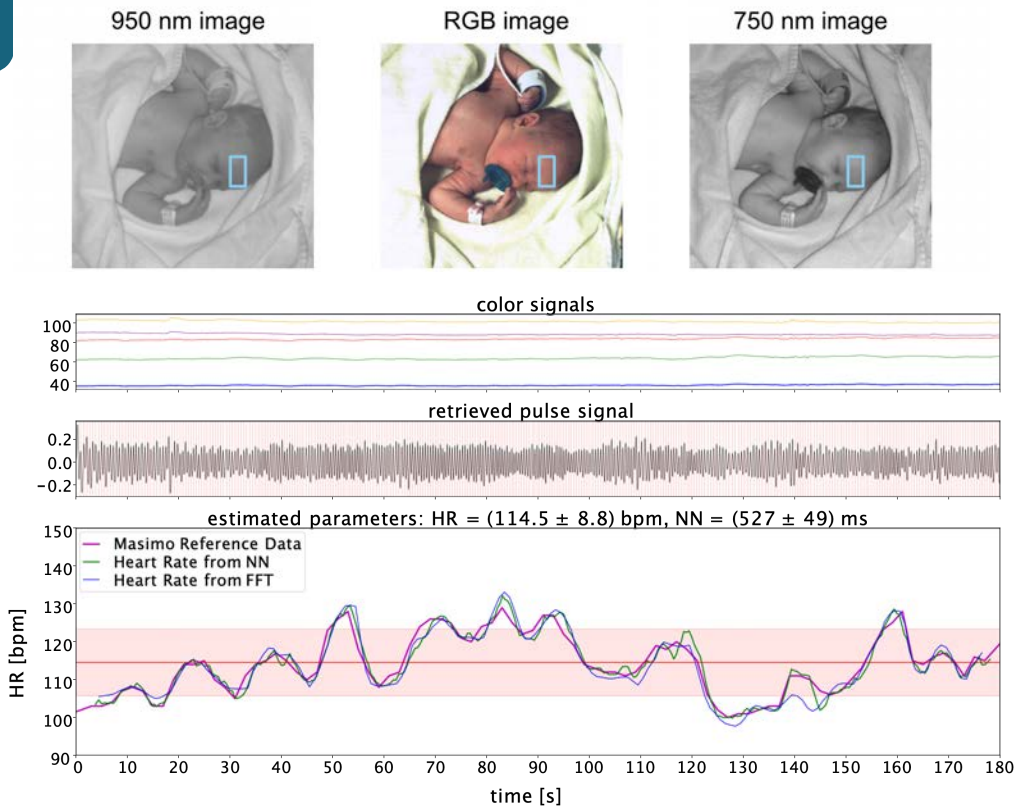


BACKGROUND

Hemoglobin absorption

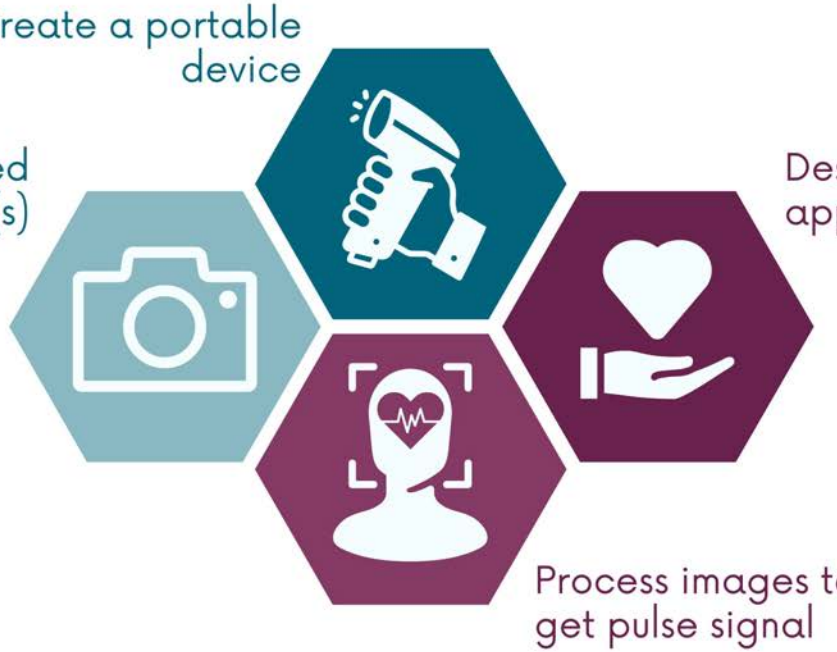


Spectral signals from images



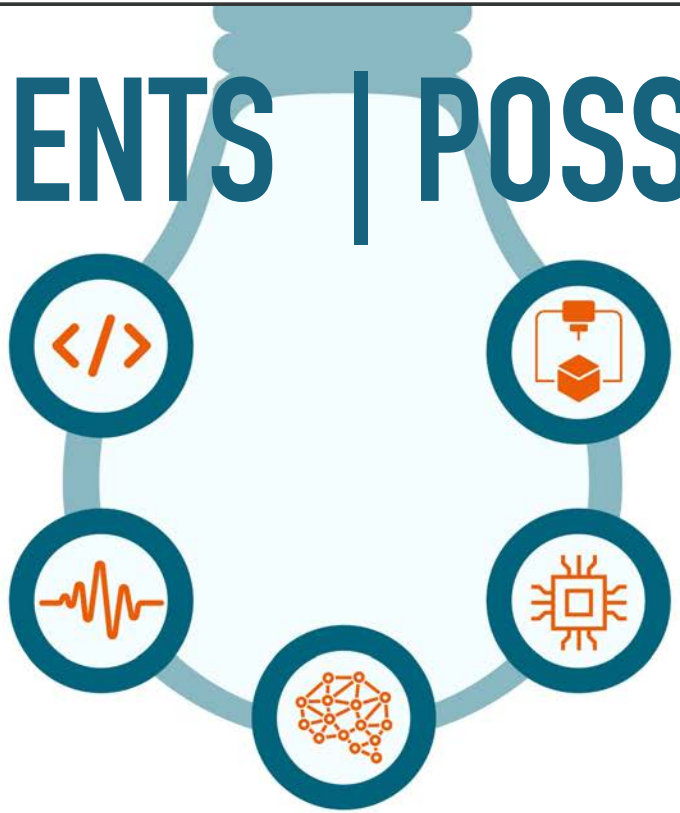
CHALLENGE: BUILD A MEDICAL TRICORDER FOR HEART RATE MEASUREMENT

Spok | Tricorder | Star Trek



Xsight Optics

REQUIREMENTS | POSSIBILITIES



Programming

Python | C++

3D printing

CAD design | prototyping

Signal analysis

statistical methods | FFT

Electronics

embedded computing

Machine learning

face detection | CNN | openCV

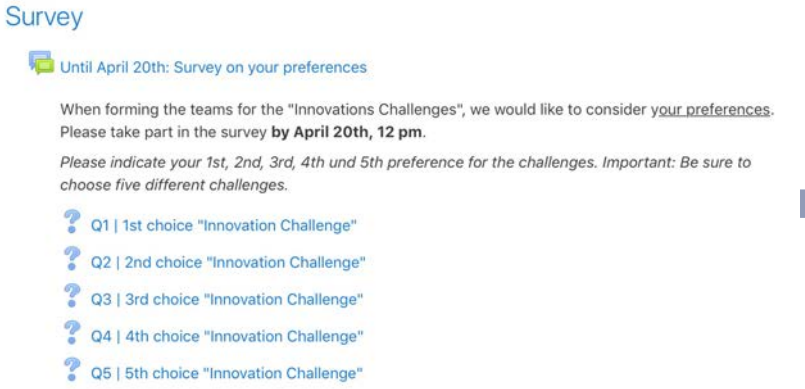
Contact: j.sperrhake@xsightoptics.de

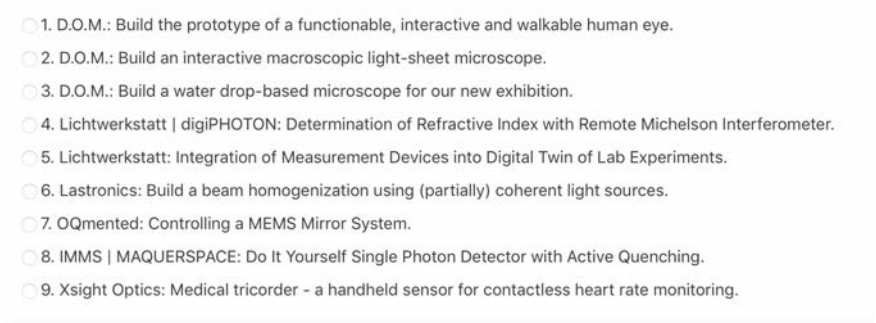
END
Innovation Challenges Presentations

What's next!?

Innovation Projects & Teams

Please take part in the **survey (Q1 – Q5)** at MOODLE by **April 20th, 12 pm!**





Project outcomes & ownership of ideas

- In this course we will operate with a **Makerspace / Open Source mindset.** We share the ideas and results freely among all participants.

- If you realize during the semester you would like to commerzialize some of the ideas **reach out to us** and we will find a satisfying solution.

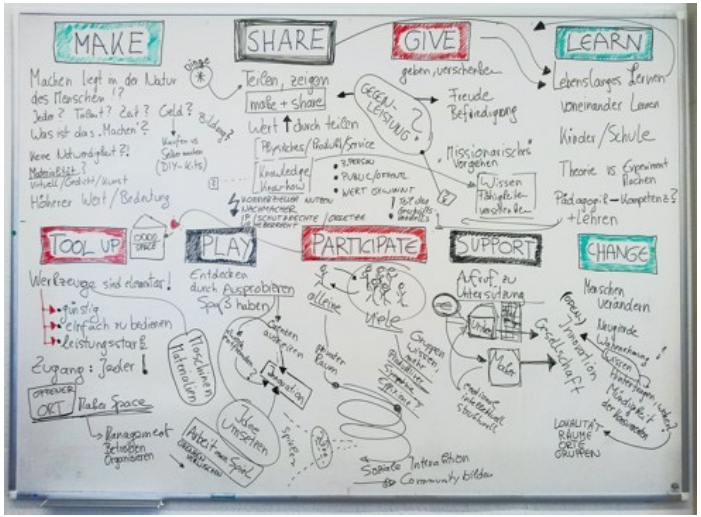


Figure 1: Principles of the Maker Movement (Hatch, 2013).

Wrap up and Q&A

- **Participation in-person is preferred**
- **Theoretical** and **practical perspectives** with different lectureres
- **Hands-on** team learning experience through integration of workshops and innovation projects
- Work **autonomously** on your **innovation project** with support from your project Mentors and the Lichtwerkstatt team
- **Discord channel** for team communication [Link in MOODLE]
- All slides and innovation project descriptions will be uploaded to MOODLE

Literature to start with…

- Brown, T. (2008). Design thinking. Harvard business review, 86(6), 84.
- Chesbrough, H. W. (2003). Open innovation: The new imperative for creating and profiting from technology. Harvard Business Press.
- Chesbrough, H., Vanhaverbeke, W., & West, J. (Eds.). (2006). Open innovation: Researching a new paradigm. Oxford University Press.
- Curedale, R. (2019). Design Thinking Process and Methods. USA: Design Community College.
- Gershenfeld, N. A. (2005). Fab: the coming revolution on your desktop - from personal computers to personal fabrication. Basic Books (AZ).
- Hatch, M. (2013). The maker movement manifesto: Rules for innovation in the new world of crafters, hackers, and tinkerers. McGraw Hill Professional.
- Osterwalder, A., & Pigneur, Y. (2010). Business model generation: a handbook for visionaries, game changers, and challengers. John Wiley & Sons.
- Ries, E. (2011). The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses. Currency.
- Walter-Herrmann, J., & Büching, C. (Eds.). (2014). FabLab: Of machines, makers and inventors. transcript Verlag.