

Quantitative Phase Imaging at Cellular Level

This one-day hands-on training course is designed for:

- industry and SMEs, especially those developing new 2D and 3D microscopic instrumentation (incl. sensors) – it refers to **Free Space Optics Platform** and **Metrology Platform**;
- companies, medical centers or research institutions addressing the needs of such sectors as biomedical diagnosis, cell and tissues factories, pharmaceutical and veterinary sector – it refers to **Photonics for Biomedical Applications**.

The course provides the detailed overview of quantitative phase imaging (QPI) devices (hardware and software) and their applications in laboratory and clinical environments.

The course focuses on three technology demonstrators and their applications:

- Digital Holographic Microscope (DHM) for phase/dry mass measurement and monitoring in biological cells and cell cultures;
- Fourier Ptychographic Microscope (FPM) for amplitude and phase imaging of large field of views and high resolution of histopathological samples;
- Optical Diffraction Tomograph (ODT) for 3D QPI of refractive index distribution in cells/cell cultures/tissues.
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The course attendees will learn how these devices are designed, built, calibrated, validated and how the data are processed and analyzed. Specifically, different approaches to hologram processing and tomographic reconstruction will be described and their relation to the accuracy of 2D and 3D retrieved biomedical data will be discussed.

The uniqueness of this Demo Center lies in providing the **in-depth understanding and transferring the competences on the label-free quantitative phase imaging devoted to biomedical applications at cellular level**. The QPI devices are not presented as “black-boxes”, but several hardware and software alternative solutions are showcased through the hands-on experiences and thoroughly discussed. These novel tools in phase microscopy have already started their way to the market (example companies providing commercial systems: LynceeTec, Nanolive, Tomocube), however there is still a lot of space at the market for new QPI devices focusing on a variety of applications in biomedicine (histopathology, pharmacology, cell factories, veterinary (e.g., optimization of fertilization procedures)). In relation to QPI applications the uniqueness of this Demo Center relies on **its metrology focus**, i.e., providing in-depth knowledge on calibration and validation of QPI results in 2D and 3D.

Attendees will have access to the Photonics Labs at the Faculty of Mechatronics WUT and specifically to the laboratory devoted to QPI for Biomedical Applications located at the Institute of Micromechanics and Photonics WUT.



The Laboratory is equipped with the following custom made systems:

- Digital Holographic Microscope with full data processing path in a single and stitched (large) field of view (TRL 7),
- Fourier Ptychographic Microscope for large field of view high-resolution imaging (TRL 5),
- Optical Diffraction Tomographs (Holographic Tomographs, HT) with limited angle of projections for 3D RI determination. Two HT versions: (i) for static/slowly variable scenes (TRL 7) and for dynamic events analysis (TRL 7).



The number of people **per course 2/3/6** – we assume that the hands-on training will be performed at each of the Demos by max of 2 persons teams. Three instructors will be available whole day of the course, receiving sequentially 1 or 2 persons for hands-on training at each of the Demos. If requested **the access to data analysis software and consultations** will be granted for three working days after the course. **Each of the Demos can be given alternatively in two versions: (i) Course for the Beginners and (ii) Advanced Course.**

We plan to run this courses two times per year. The most suited periods are: **February and September.**

Two parts of the training course (**Demo1: DHM and Demo3: ODT**) have already be given within the MSc course of Photonics Engineering Specialization in the form of 2 hours laboratories per each of the device. Also the individual courses for the external visitors from: the Institute of Experimental Biology (biologists) and Warsaw Medical University (medical doctors) as well as from the companies:

AM2M Ltd and Precoptics Ltd (engineers) were provided during 2019 and 2020. The courses were very well received by the participants.

The scenarios of these Demos are going to be modified in order to meet the needs of the course Attendees (and the planned time scheme) and adapt to their expectations (Beginners and Advanced Courses).

DEMO2: FPM is now ready as the laboratory station (TRL5) which has been used in the numerous measurements within international and national projects and during MSc students laboratories. For this Demo the detailed scenario for hands-on training is prepared and will be tested internally and by an external visitor (such sessions are planned for summer 2021).

The preliminary hand-out notes for **all Demos** match the detailed scenarios of the planned hands-on trainings in Demo Centres. The hand-out notes also include the selected journal papers devoted to biomedical applications.

Visit our webpage <http://biophase.pl> for well-illustrated demonstrators, their applications and the related publications.