UNIVERSITÄTS KLINIKUM jena

Department of Otorhinolaryngology, Head and Neck Surgery
Working Group Innovative Biophotonics

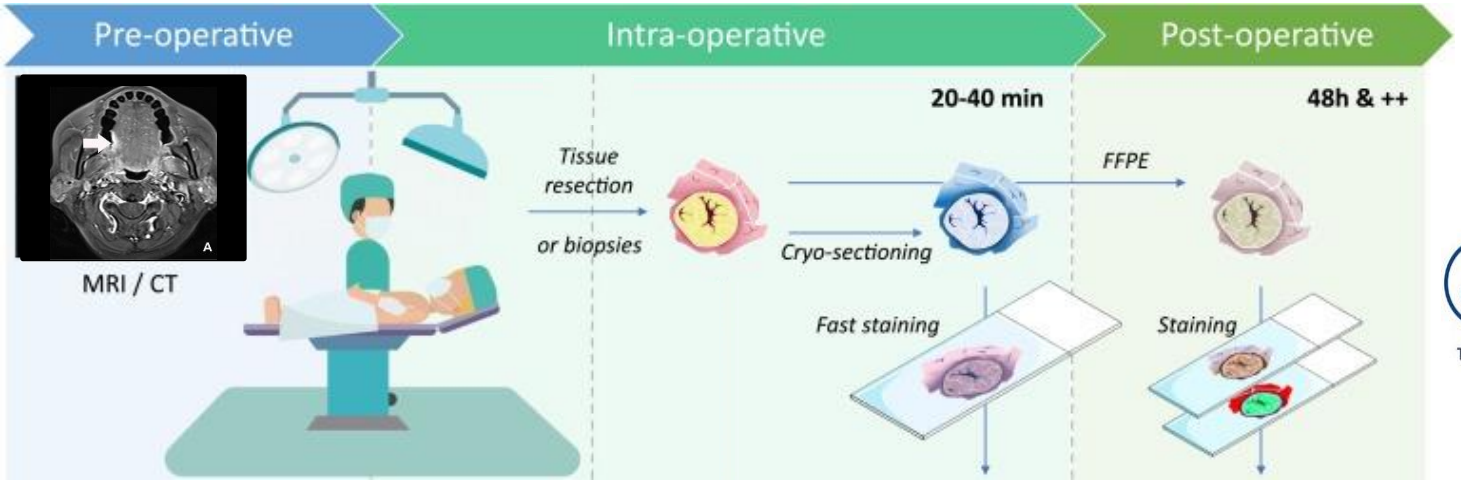
Current biophotonic imaging approaches and challenges for head and neck cancer diagnosis and therapy

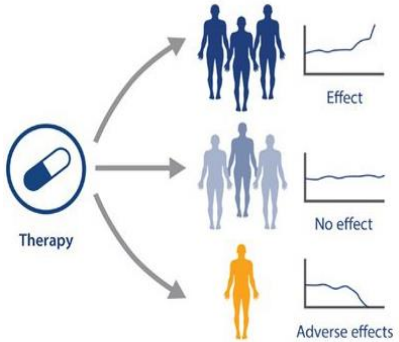
Bundesministerium für Bildung und Forschung

Antwerp, 29-11-2023

David Pertzborn

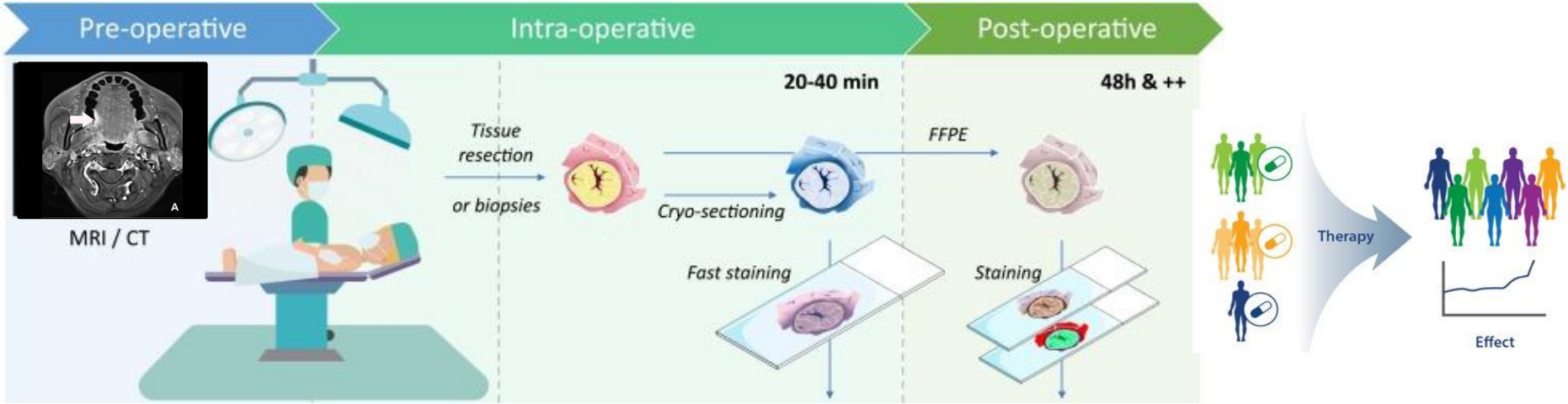
Current workflow in tumor diagnosis and therapy





Subjective
Time consuming
No therapy prediction

Biophotonic approaches to overcome current limitations in tumor management

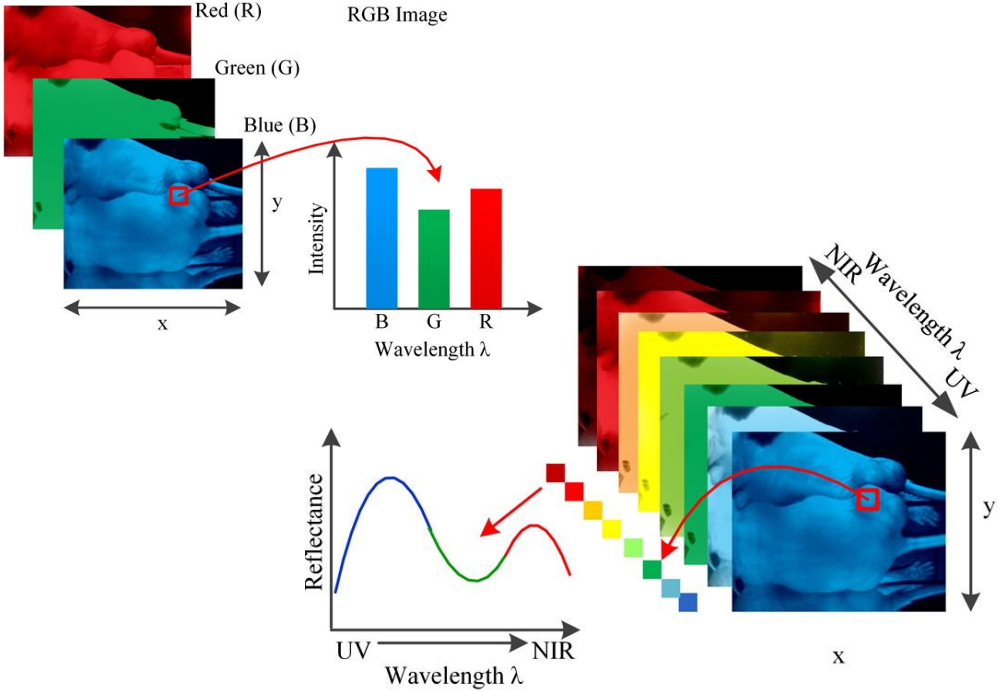


Hyperspectral Imaging
- Yes/No tumor decision

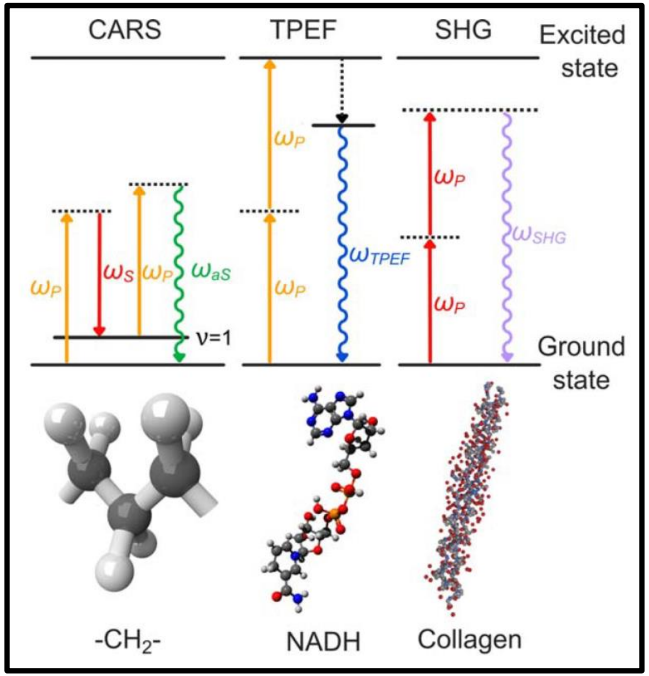
Stimulated Raman Imaging
- Deep molecular analysis
- Tumor classification & grading
- Therapy prediction

Photonic methods: two examples

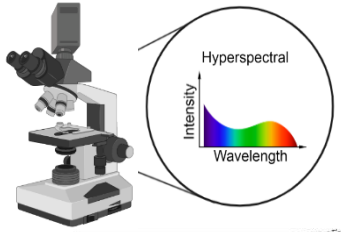
Hyper Spectral Imaging



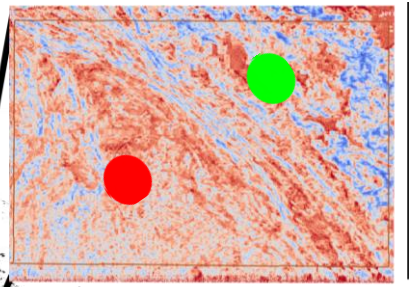
Multimodal Spectral Imaging



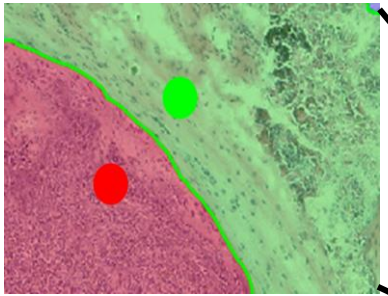
Guolan Lu, Baowei Fei, "Medical hyperspectral imaging: a review," J. Biomed. Opt. 19(1) 010901 (20 January 2014)
https://doi.org/10.1117/1.JBO.19.1.010901

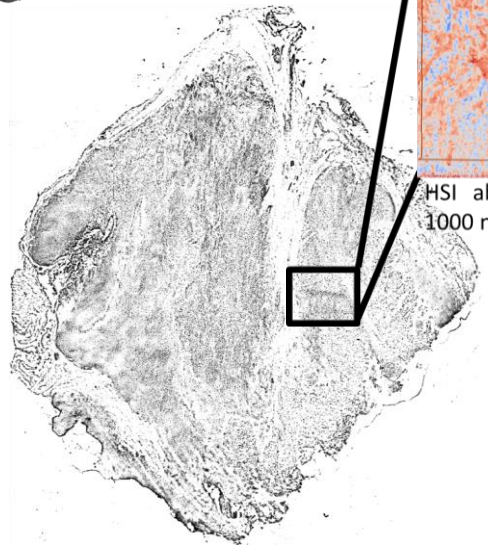


Hyperspectral imaging for intraoperative assessment

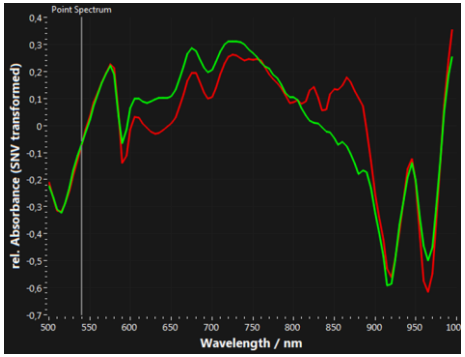


HSI absorption intensity image at 1000 nm

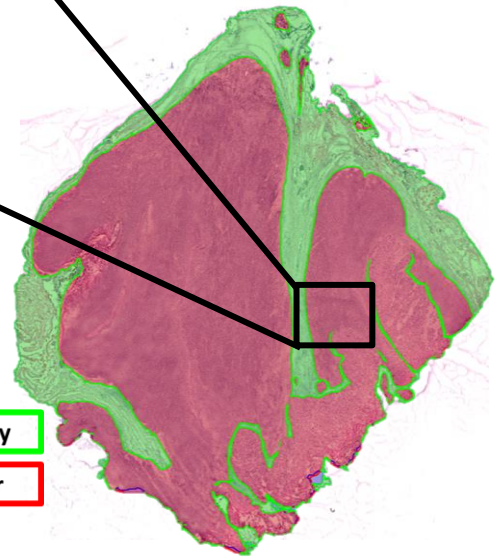




Unstained fresh frozen section

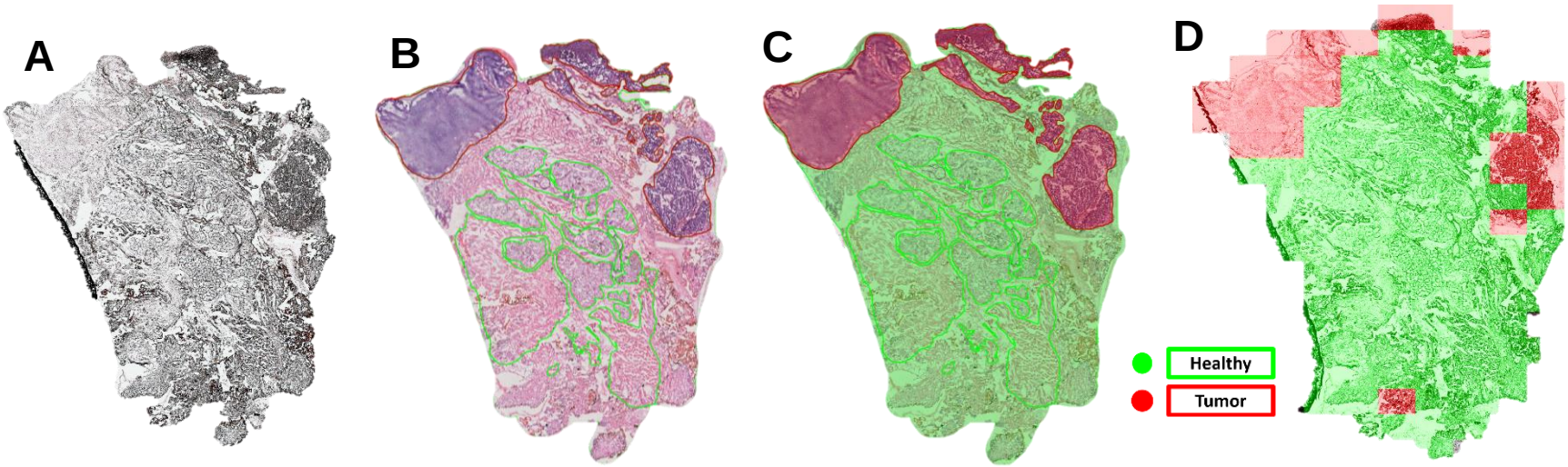


Spectra of the tumor and healthy regions



H&E staining after HSI measurement + manual annotation

Hyperspectral imaging enables automated tumor recognition with 0.76 accuracy



unstained tissue section

H&E stained tissue section

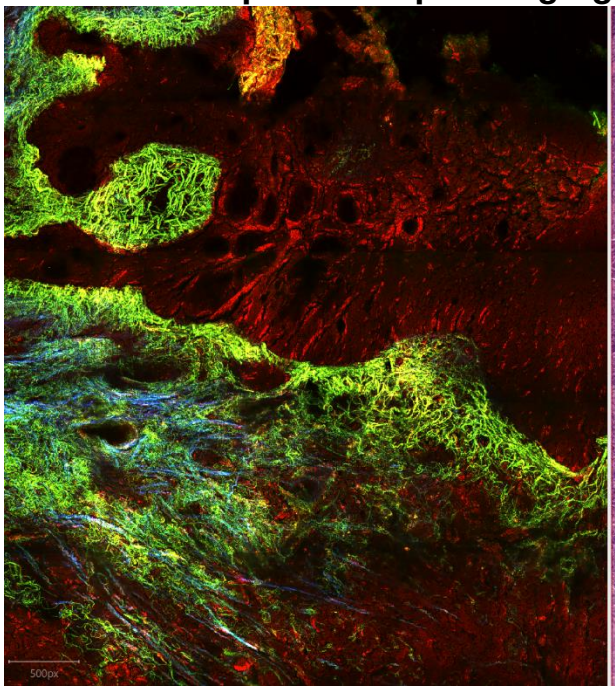
manual histopathological annotations

tumor classifications results based on hyperspectral data

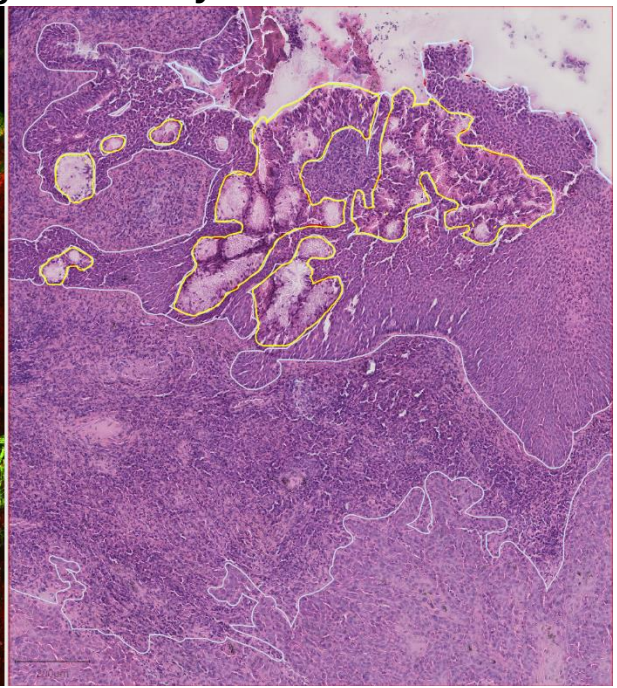
Pertzborn D, … F, Hoffmann F. Intraoperative Assessment of Tumor Margins in Tissue Sections with Hyperspectral Imaging and Machine Learning. Cancers. 2023; 15(1):213

Multimodel Spectroscopy allows for deep molecular visualization

Multimodal Spectroscopic Imaging



manually annotated tumor areas



Higher CH_2 density in tumor area

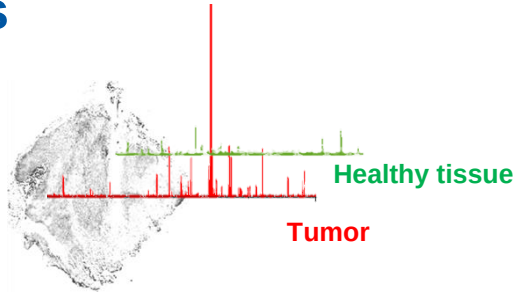
↓

information on **tumor presence**

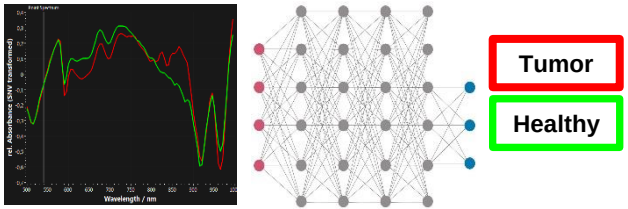
Decision between cancer and non-cancer area

Advantages of biophotonic imaging applications

- Staining and label-free detection of molecular signatures



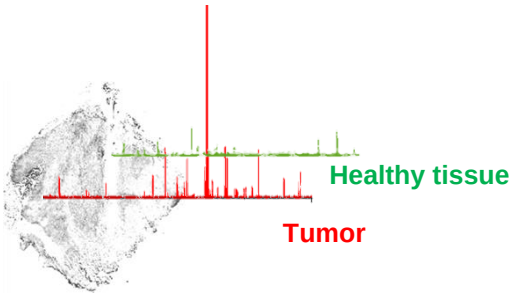
- Spectroscopic data and deep learning methods allow for automated tissue classification



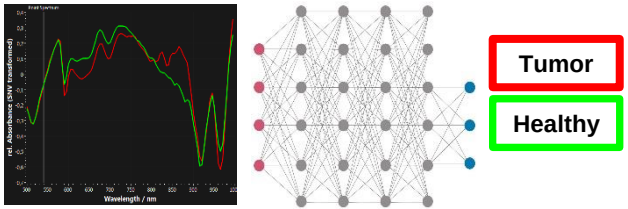
- Objective and quantitative molecular assessment for personalized medicine

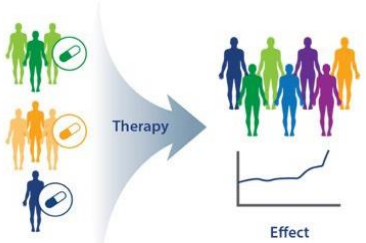
Challenges of biophotonic imaging applications

- Staining and label-free detection of molecular signatures ← But what do we see?



- Spectroscopic data and deep learning methods allow for automated tissue classification ← Based on imperfect training data
- Objective and quantitative molecular assessment for personalized medicine ← But the transition to the clinics is hard

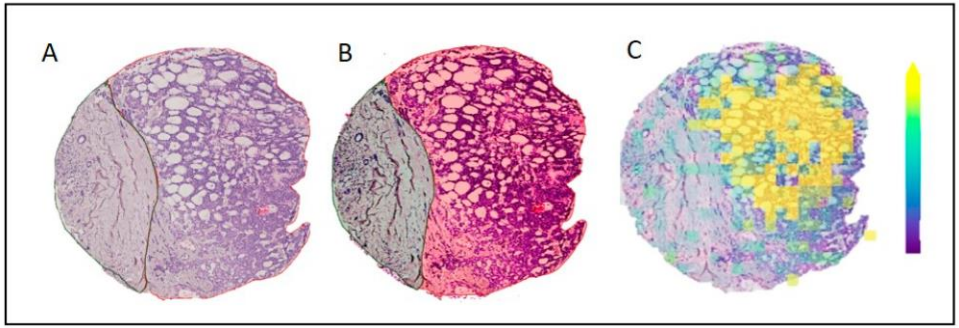




Our approaches

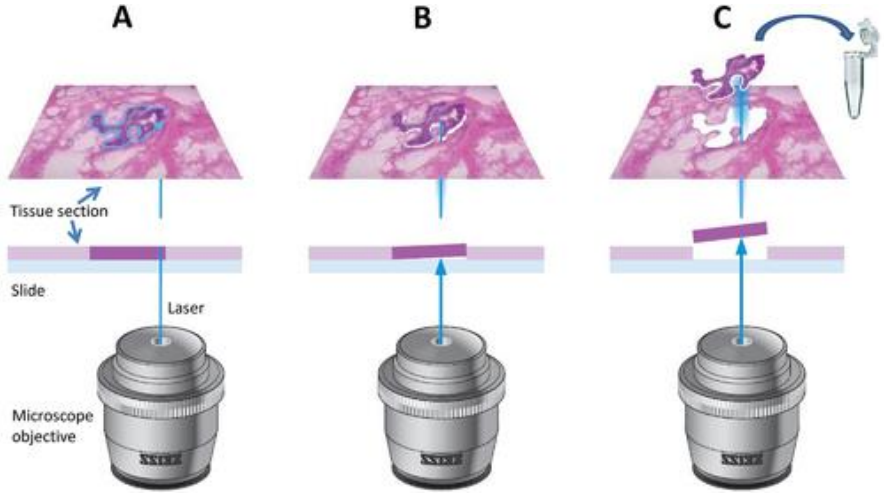
- But what do we see?
- Based on imperfect training data

MALDI Imaging



Spatially resolved mass spectrometry in comparison with histopathological annotations

Microdissection



Baseline for further proteomic or genomic analysis

Pertzborn, David, et al. "Multi-Class Cancer Subtyping in Salivary Gland Carcinomas with MALDI Imaging and Deep Learning." Cancers 14.17 (2022): 4342.

von Eggeling, Ferdinand, and Franziska Hoffmann. "Microdissection—An essential prerequisite for spatial cancer omics." Proteomics 20.17-18 (2020): 2000077.

Our approaches

- But the transition to the clinics is hard

Just do it

- Clinical + technological partner
- Prospective clinical trial RAMAN-HNSCC at the Jena University Hospital (DRKS00028114)
- Recording Raman spectra of oropharyngeal carcinoma in-vivo
- Raman probe developed at the Leibniz Institute of Photonic Technology, Jena, Germany

Acknowledgement

Innovative Biophotonics

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CRI chemometric imaging

CNR IFN Istituto di Fotonica e Nanotecnologie

charm

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TROPHY

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