

PANIR: PHOTOACOUSTIC NEAR-INFRARED SPECTROSCOPY FOR MONITORING PRETERM BIRTH

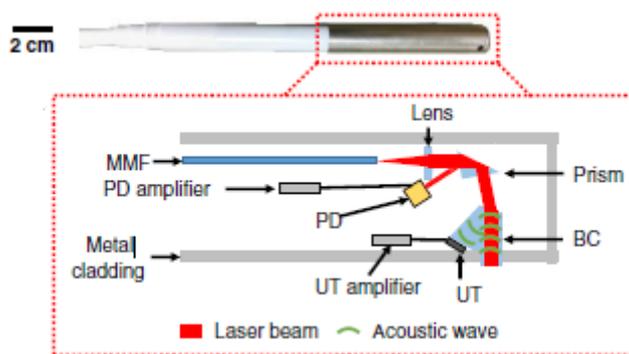
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Technology Description

An interdisciplinary team of researchers has developed a photoacoustic near-infrared (PANIR) probe to predict preterm birth by quantifying water content in cervical tissue (an early and objective indicator of cervical remodeling). This compact photoacoustic endoscopy probe utilizes a pentaprism beam combiner to eliminate the need for coupling media and thereby accurately measure cervical tissue hydration from near infrared spectra.

Premature cervical remodeling is marked by increased tissue hydration and is a critical indicator of impending spontaneous preterm birth. Traditional clinical measurements of cervical remodeling are subjective and only detect late events (e.g., cervical effacement and dilation). Combining photoacoustic endoscopy with near infrared spectroscopy could offer a minimally-invasive, objective, quantified measure of cervical water content. However, conventional photoacoustic coupling media makes it difficult to separate the infrared signal emitted by the tissue. This new PANIR system solves that problem by carrying the photoacoustic signals directly from the tissue to the transducer, eliminating the need for a coupling medium. The compact probe is configured to accurately measure cervical tissue hydration during pregnancy, thus enabling in vivo characterization and monitoring of cervical remodeling using PANIR spectra. This device could be used to study preterm birth in animals or as a clinical tool to evaluate risk in pregnancy and potentially enable early interventions with improved outcomes for both the mother and infant.



PANIR system. Photograph of a PANIR probe prototype and schematic drawing of the components (BC, beam combiner; MMF, multimode fiber; PD, calibrated photodiode; UT, ultrasonic transducer).

Stage of Research: The inventors built a prototype PANIR probe and used hydrogel phantoms to demonstrate that it can quantify water content. They validated the results by tracking cervical water content in over 200 women throughout their pregnancy.

Publications: Qu, Y., Hu, P., Shi, J., Maslov, K., Zhao, P., Li, C., ... & Pizzella, S. (2018). [In vivo characterization of connective tissue remodeling using infrared photoacoustic spectra](#). *Journal of Biomedical Optics*, 23(12), 121621.

Applications

- **Medical diagnostics** – photoacoustic endoscopy of cervical tissue could provide a sensitive method for predicting preterm birth
- **In vivo spectroscopy** in animal models for basic research of cervical physiology and remodeling

Key Advantages

- **Compact device** – the components of the device fit in a millimeter diameter scale probe to image tissue that is inaccessible by tabletop systems
- **Objective, early in vivo indicator** of cervical remodeling could improve pregnancy management:
 - enables **quantitative** measure of water content in photoacoustic endoscopy by using a N-BK7 pentaprism instead of a conventional water-based coupling medium that interferes with near-infrared detection
 - detects remodeling much earlier than traditional observations (e.g., effacement and dilation)
- **Minimally invasive** – endoscopy does not require an invasive biopsy

Patents: Application pending