Transabdominal Measurement of Fetal Oxygen Saturation and Blood Flow Index through Multi-exposure Time-of-flight Filtered Interferometric Diffusing-wave Spectroscopy

Tech ID: 34829 / UC Case 2025-479-0

ABSTRACT

Researchers at the University of California, Davis have developed a noninvasive optical technology that simultaneously measures fetal oxygen saturation and blood flow during labor through advanced interferometric spectroscopy.

FULL DESCRIPTION

This technology employs multi-exposure time-of-flight filtered interferometric diffusing-wave spectroscopy (multi-exposure TOF-iDWS) using laser light split between a reference and sample arm to noninvasively probe the maternal abdomen. By rapidly sweeping laser wavelengths and controlling optical path differences, it selectively detects light signals from both maternal superficial tissue and deeper fetal tissue. Varying camera exposure times and computational algorithms enable extraction of both blood flow index and oxygen saturation for mother and fetus with enhanced signal fidelity. The system can be realized with fiber optics, free-space optics, or a hybrid, using a variety of light delivery and collection methods.

APPLICATIONS

- Monitoring of fetal oxygen saturation and blood flow during labor and delivery.
- Assessment tool to decide on cesarean section or instrumental vaginal delivery.
- Noninvasive fetal health evaluation in prenatal care centers and hospitals.
- Potential expansion into monitoring oxygenation and blood flow in other deep multilayer tissues such as the brain.
- Medical devices integrating optical sensing for maternal-fetal health management.

FEATURES/BENEFITS

- High collection throughput enabling detection of weak fetal signals.
- Time-of-flight filtering to selectively isolate deep fetal tissue signals and suppress maternal interference.
- Simultaneous measurement of fetal blood flow index and oxygen saturation during labor.
- Enhanced signal-to-noise ratio and robustness against noise via multi-exposure strategy.
- Non-invasive and real-time monitoring suitable for intrapartum fetal health assessment.
- Flexible optical system implementations (fiber optics, free-space, hybrid).
- Overcomes poor signal quality and low fetal signal penetration common in existing fetal pulse oximetry.
- Separates weak fetal signals from dominant maternal tissue signals noninvasively.

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OTHER INFORMATION

KEYWORDS

blood flow index, fetal health monitoring, fetal oxygen saturation, interferometric diffusing-wave spectroscopy, multi-exposure, noninvasive, optical interferometer, transabdominal, time-of-flight filter, wavelength sweeping

CATEGORIZED AS

- **Optics and Photonics**
  - All Optics and Photonics

- Addresses safety concerns by improving signal collection without increasing illumination intensity.
- Provides a combined blood flow and oxygen saturation metric, which was previously unavailable in optical fetal monitoring.

PATENT STATUS

Patent Pending

- **Medical**
  - Devices
  - Diagnostics
  - Disease: Autoimmune and Inflammation
  - Disease: Women's Health
  - Imaging
- **Sensors & Instrumentation**
  - Analytical
  - Medical

RELATED CASES

2025-479-0

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Large Field-Of-View Two-Photon Miniscope with Compact Footprint
- Two-Photon Miniscope with Elliptical Point-Spread-Function and Temporal Focusing Scheme
- TransPPGSep: Fetal Signal Separation using Physically and Physiologically Compliant Synthetic Data
- Accurate, Non-Invasive Fetal Arterial Oxygen Saturation and Blood Ph Measurement via Diffuse Optics
- Fetal Oximetry Measurement via Maternal Transabdominal Spectroscopy
- Method and System for Signal Separation in Wearable Sensors with Limited Data (with Applications to Transabdominal Fetal Oximetry)
- Systems, Methods, and Media for Determining Fetal Photoplethysmography Information from Non-Invasively Obtained Mixed Photoplethysmography Signals
- Metasurface, Metalens, and Metalens Array with Controllable Angular Field-of-View

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