

TransPPG-Sep: Fetal Signal Separation using Physically and Physiologically Compliant Synthetic Data

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ABSTRACT

Researchers at the University of California, Davis have developed a machine learning system for accurately separating fetal signals from mixed maternal-fetal photoplethysmography signals acquired non-invasively to enable fetal physiological parameter monitoring.

FULL DESCRIPTION

This technology provides systems, methods, and media that leverage a machine learning model trained on a physics-compliant synthesized mixed photoplethysmography (PPG) dataset, (optionally fine-tuned with in-vivo data), to separate fetal source signals from non-invasively obtained mixed maternal-fetal PPG signals. The synthesized data simulates physiologically plausible components including fetal and maternal PPG and maternal respiration, generated through light transport simulations and probability models. The extracted fetal signals enable accurate estimation of critical fetal parameters such as fetal blood oxygen saturation and blood pH within the maternal abdomen. The model also computes a separation quality index to validate signal integrity, improving fetal monitoring through advanced, non-invasive means.

APPLICATIONS

- ▶ Intrapartum fetal monitoring and assessment in obstetrics.
- ▶ Non-invasive prenatal diagnostics and fetal health screening.
- ▶ Development of wearable and portable maternal-fetal monitoring devices.
- ▶ Remote and telehealth maternal-fetal care solutions.
- ▶ Research tools for fetal physiology and developmental studies.
- ▶ Integration into hospital monitoring systems to supplement or replace invasive monitoring.
- ▶ Signal processing solutions for medical device manufacturers specializing in optical biosensing.

FEATURES/BENEFITS

- ▶ Enables non-invasive, accurate extraction of fetal PPG signals from mixed maternal-fetal data.
- ▶ Utilizes a physics-based synthesized training dataset to enhance machine learning model reliability and address training data limitations.
- ▶ Incorporates advanced attention-based neural networks for effective and refined signal separation without prior signal knowledge.

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OTHER INFORMATION

KEYWORDS

additive noise, attention-based neural network, blood oxygen saturation, fetal photoplethysmography, maternal respiration, machine learning model, mixed photoplethysmography signals, non-invasive monitoring, signal separation, transabdominal optical probe

- ▶ Validates and fine-tunes models with measured in-vivo data to improve real-world applicability and generalizability.
- ▶ Generates a separation quality index for assessing signal extraction reliability.
- ▶ Facilitates critical fetal physiological monitoring, including blood oxygen saturation and pH.
- ▶ Separates overlapping maternal and fetal PPG signals that are difficult to distinguish using traditional methods.
- ▶ Addresses the biomedical challenge of blind source separation and overcomes the limitations of conventional biosignal processing.
- ▶ Eliminates dependence on invasive fetal monitoring procedures, improving safety for maternal-fetal care.
- ▶ Enables extraction of fetal signals even in the presence of maternal respiration and noise interference.

CATEGORIZED AS

- ▶ **Biotechnology**
 - ▶ Health
- ▶ **Imaging**
 - ▶ Medical
- ▶ **Medical**
 - ▶ Diagnostics
 - ▶ Imaging
- ▶ **Sensors & Instrumentation**
 - ▶ Biosensors

RELATED CASES

2026-418-0

PATENT STATUS

Patent Pending

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ [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](#)

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