Second Laureate Innovation

◆ Project title: **Extraction of Fetal Cardiac Signals from an Array of Maternal Abdominal Recordings**

◆ Representative: **Reza Sameni (PH.D.)**

Abstract:

The objective of this research was to improve the signal processing aspects of noninvasive fetal cardiography and to provide better insights of this problem, by developing new techniques for the modeling and filtering of fetal electrocardiograms (ECG), recorded from an array of electrodes placed on the maternal body surface. The idea behind the developed methods is to use a priori information about cardiac signals, such as their pseudo-periodicity, to improve the performance of the currently existing schemes and to design novel filtering techniques customized for cardiac signals. Theoretically, the proposed methods are combinations of morphological models of the ECG, ad hoc Bayesian filtering techniques, and special classes of spatial filters adapted from the blind and semi-blind source separation context. It is shown that due to the generality of these methods, the same procedures are applicable to multichannel adult ECG recordings and can be used in real-time cardiac monitoring systems. Moreover, since the developed methods are based on the cardiac signal morphology, the same methods are applicable to other cardiac monitoring modalities such as the magnetocardiogram (MCG), which are morphologically similar to the ECG. A case study of this method is presented for the extraction of twin fetal MCG signals.

Moreover, an advanced deflation technique is presented, which is able to separate subspaces of desired signals from degenerate mixtures of signal and noise. This idea has found various applications in other signal processing contexts.