# 2SC8094 – Non-invasive extraction of the fetal electrocardiogram

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**Language of instruction:** FRANCAIS
**Campus:** CAMPUS DE METZ
**Workload (HEE):** 80
**On-site hours (HPE):** 48,00

**Description**
The project, which is part of the ST7-Optimization "Source separation for optimal use of signals", will focus on a source separation issue raised by a client partner: INSERM in Nancy.

Non-invasive fetal electrocardiography (NI-FECG) represents an alternative fetal monitoring technique to traditional Doppler ultrasound, which is non-invasive. However, despite significant advances in adult ECG signal processing over the past decades, analysis of NI-FECG remains difficult and largely unexplored. This is mainly due to the relatively low signal-to-noise ratio of the FECG compared to the maternal ECG, which overlaps in both time and frequency.

The problem therefore consists in finding one or more data representation spaces well suited to the problem of fetal ECG extraction. It will be a question of applying and testing one or more methods starting from an article which reviews recent advances in research on NI-FECG, in particular: databases accessible to the public, techniques of NI-FECG extraction for fetal heart rate assessment and morphology analysis, NI-FECG simulators, and methodology and statistics to assess the performance of extraction algorithms.

**Quarter number**
ST7

**Prerequisites (in terms of CS courses)**
Probability 1A (CIP-EDP, 1SL1000),
Signal processing ST4 (1CC4000)
Statistics, Machine learning and Data processing ST4 (1CC5000),
Digital environment, computer and programming SG1 (1CC1000).

**Syllabus**
Evaluation and implementation of non-invasive fetal ECG extraction algorithms, based on the article by Joachim Behar et al. “A practical guide to non-invasive fetal electrocardiogram extraction and analysis”, Physiol. Meas. 37, 2016.

**Class components (lecture, labs, etc.)**
This teaching is done in the form of a project.

Throughout the duration of the project, students will be asked to keep an up-to-date "laboratory notebook" specifying in a few lines for each experiment or test carried out, its motivations, the results obtained, the source codes and the data used. During the last week dedicated to the project, students will be asked to:

- provide a project report; and
- to carry out a defense in the presence of the partner.

A progress update on the project with reading of the "laboratory notebook" and the provisional version of the report will take place regularly.

**Grading**
Skills will be assessed:

- in continuous control at the advancement points, the "laboratory notebook" reading and the draft report reading (individual note CC);
- during the final defense (individual note S).

In addition, the quality of the deliverables: final report, "laboratory notebook" and commented source codes, will be evaluated (note QL). Final score = CC/3 + S/2 + QL/6.

In case of a justified absence to one of the intermediary examinations, the grade of this latter is replaced by the grade of the final defense.

The assessment of skills is specified in the paragraph "Description of acquired skills"

**Course support, bibliography**
Joachim Behar, Fernando Andreotti, Sebastian Zaunseder, Julien Oster and Gari D Clifford, “A practical guide to non-invasive fœtal electrocardiogram extraction and analysis”, Physiological Measurement, 37, R1 – R35, 2016.

**Resources**

80 HEE (48 HEE) of project carried out in groups of students.

**Learning outcomes covered on the course**

At the end of this course, students will be able to:
- represent and decompose electrocardiograms in an "optimal" way;
- fit a model to data;
- use a programming language to effectively implement a data processing algorithm.

**Description of the skills acquired at the end of the course**

C4 : Have a sense of value creation for his company and his customers (assessed during project monitoring)
C6 : Be operational, responsible, and innovative in the digital world (assessed throughout the project)
C7 : Know how to convince (evaluated during the follow-up, during the defense and in the deliverables)
C8 : Lead a project, a team (evaluated by laboratory notebooks)