M1/M2 Intership position
Sparse learning for fetal heart rate characterization

Key-words – Sparse learning, CNN, proximal algorithms, fetal heart rate

Location: SYSIPH team, Laboratoire de Physique de l'ENS Lyon
46 allée d'Italie, 69364 Lyon cedex 07

Advisors : Patrice Abry & Nelly Pustelnik
email : patrice.abry@ens-lyon.fr, nelly.pustelnik@ens-lyon.fr
téléphone : 04 72 72 84 93 / 86 49
web : `http//perso.ens-lyon.fr/patrice.abry`
ou `http//perso.ens-lyon.fr/nelly.pustelnik`

When : 4-6 month between february and september 2021.

Context – Fetal Heart Rate (FHR) monitoring is used during delivery for fetal well-being assessment. Classically based on the visual evaluation of FIGO criteria, FHR characterization remains a challenging task that continuously receives intensive research efforts. Research works aimed at devising automated acidosis prediction procedures are either based on designing new advanced signal processing analyses or on efficiently combining a large number of features proposed in the literature.

In a previous work [1], we consider sparse learning to perform jointly feature selection and acidosis prediction, hence producing an optimal decision rule based on few features among a set of 20 features (gathering "FIGO-like" features, classical spectral features and recently proposed scale-free features). Considering recent advances combining non-smooth optimization and deep learning, we aim to revisit the sparse learning procedure we proposed as a deep learning framework by unroling the proximal algorithm iterations as in [2], possibly with quadratic interaction following [3].

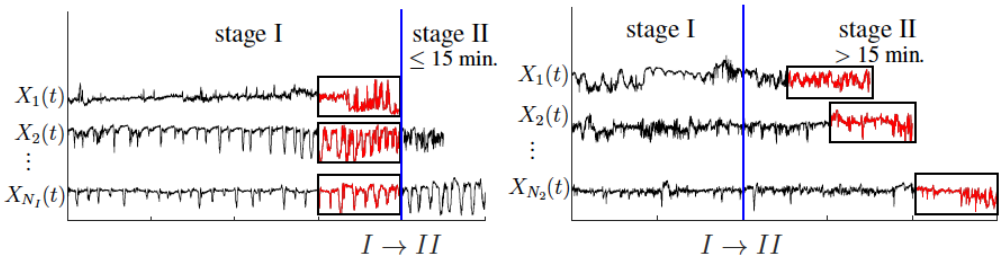

Figure 1. Stage splitting. Analyzed FHR data are marked by the time windows framed in rectangles boxes, corresponding to the last 20min of StageI (for StageI dataset, left) and the last 20 min before delivery for StageII dataset (right).

Subject – This internship is devoted to the design of a neural network for the specific task of sparse learning and its application to FHR monitoring:

- the design of the network;
- the performance evaluation on synthetic and real data;
- the comparison with the previous sparse learning method and standard CNNs.

Skills: The candidate must have have skills in some of the following areas: Signal and Image Processing, Data science, Optimization, Machine Learning.

Application: The deadline for applications to this post is 30 november 2020. Applicants must send by email a CV and a statement of interest to Nelly Pustelnik and Patrice Abry. For further information, candidate can contact us with questions related to this position.

PhD follow up: This internship may be continued by a PhD.

References:

[1] P. Abry, J. Spilka, R. Leonarduzzi, V. Chudácek, N. Pustelnik, M. Doret, Sparse learning for Intrapartum fetal heart rate analysis, Biomedical Physics & Engineering Express, vol. 4, no. 3, 034002, 2018. (PDF).

[2] M. Jiu, N. Pustelnik, A deep primal-dual proximal network for image restoration, submitted, 2020. (PDF).

[3] M. Jiu, N. Pustelnik, S. Janaqi, M. Chebre, P. Ricoux, Sparse hierarchical interaction learning with epigraphical projection, Journal of Signal Processing Systems, 92, pp. 637-654, 2019(PDF)