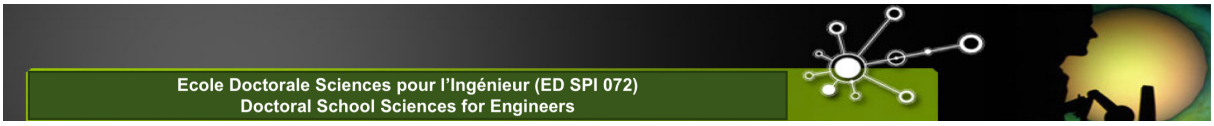

Titre Thèse (subject)	**Towards Automatic Contact-Free Assessment of pain using artificial Intelligence: TACFAI**	
Directeur (supervisor)	Pr Abdelmalik Taleb-Ahmed	E-mail : Abdelmalik.Taleb-Ahmed@uphf.fr
Co-Directeur (co-supervisor)	Pr Eric Granger	E-mail : Eric.Granger@etsmtl.ca
Laboratoire (research unit)	DOAE	Web :
Equipe (research team)	COMNUM	Web :
Financement prévu ☐	Contrat Doctoral Etablissement ☐ Région ☐ – Autre ☐ Contrat de recherche ☐ Préciser :	ULille ☐ UPHF ☐ Centrale Lille ☐ UGE ☐ IMT ☐ Autre ☐
Financement acquis ? ☒	Contrat Doctoral Etablissement ☐ Région ☒ – Autre ☐ Contrat de recherche ☐ Préciser :	ULille ☐ UPHF ☐ Centrale Lille ☐ UGE ☐ IMT ☐ Autre ☐

Abstract :

Towards Automatic Contact-Free Assessment of pain using artificial Intelligence: TACFAI

I. INTRODUCTION

Automatic pain assessment has significant potential diagnostic value for populations who cannot express their pain. Technologies that can automatically recognize a patient's affective state based on facial expression and voice can be an important tool for providing personalized diagnoses and therapeutic treatment plans. The main objective of this project is to investigate systems capable of assessing the pain intensity level based on multiple contact-free sensors, in scenarios where patients have difficulties articulating their pain experience. In order to provide patients with the appropriate personalized medical therapies and interventions, these systems shall also characterize the type of pain, e.g., chronic vs non-chronic. This project will focus on pain assessment and characterization, based primarily on different contact-free (e.g., facial and vocal) modalities captured in videos. In order to establish a performance baseline, we will also consider ECG signal captured with a contact sensor. In this project, new DL architectures will be investigated, developed and compared for accurate and robust spatio-temporal expression recognition based on videos. These architectures are novel in that they will combine information from multiple audio-visual modalities over time, and dynamically adapt the models fusion or gating function according to operational capturing conditions. To enhance robustness and accuracy, these new DL models will also incorporate specialized techniques for weakly-supervised learning from videos with limited and ambiguous annotations, and for deep domain adaptation to calibrate DL models with unlabeled operational data. It is expected that this multidisciplinary research will produce some cutting-edge AI techniques leading to a first working prototype for contact-free pain assessment which, ultimately, can be translated into reliable technologies for real-world clinical applications.

This project is important to increase research capacity, intensify the exchange of ideas and resources, and establish long-term collaborative links. Partners share a desire to continue to build meaningful, long-term collaborations. By focusing on the design of accurate DL models able to leverage dynamic and multi-modal fusion, weakly-supervised learning, and domain adaptation to accurate pain assessment in uncontrolled video environments, we anticipate that this project will lead to cutting-edge research that goes beyond the state-of-the-art. Results of this study will provide expertise and solutions required to deploy these DL models in hospitals and clinics. Benchmarking with videos captured in real-world scenarios will provide valuable insight into model performance, as needed to achieve a high level of performance. Finally, this project allows for training Highly Qualified Personnel (HQP)to face the current and future challenges in areas of information and communications technology (ICT) of strategic importance for all 2countries.

This work will be carried out in close collaboration with the Valenciennes hospital center (CHV) and Centre intégré universitaire de santé et de services sociaux du Nord-de-l'Île-de-Montrpal (CIUSSS-NIM)

REFERENCES

Laiadi, O., Ouamane, A., Benakcha, A., Taleb-Ahmed, A., Hadid, A. (2020). Tensor cross-view quadratic discriminant analysis for kinship verification in the wild. Neurocomputing, 377, 286-300.

O. Guehairia, A. Ouamane, F. Dornaika, and A. Taleb-Ahmed. Feature fusion via deep random forest for facial age estimation.NeuralNetworks, 130:238±252, 2020.

Laiadi, O., Ouamane, A., Benakcha, A., Taleb-Ahmed, A., & Hadid, A. (2020). A weighted exponential discriminant analysis through side-information for face and kinship verification using statistical binarized image features. Inter.Journal of Machine Learning and Cybernetics, 1-15.

W.C. de Melo, E. Granger, A. Hadid, A Deep Multiscale Spatiotemporal Network for Assessing Depression from Facial Dynamics, IEEE Transactions on Affective Computing, in press, 2020.

Carbonneau, M.-A., Granger, E., Attabi. Y., and Gagnon, G., Feature Learning from Spectrograms for Assessment of Personality Traits, IEEE Transactions on Affective Computing, 99, 2017.

Ayral, T, Pedersoli, M, Bacon, S, Granger, E., 2020. Temporal Stochastic Softmax for 3D CNNs: An Application in Facial Expression Recognition, WACV 2021.