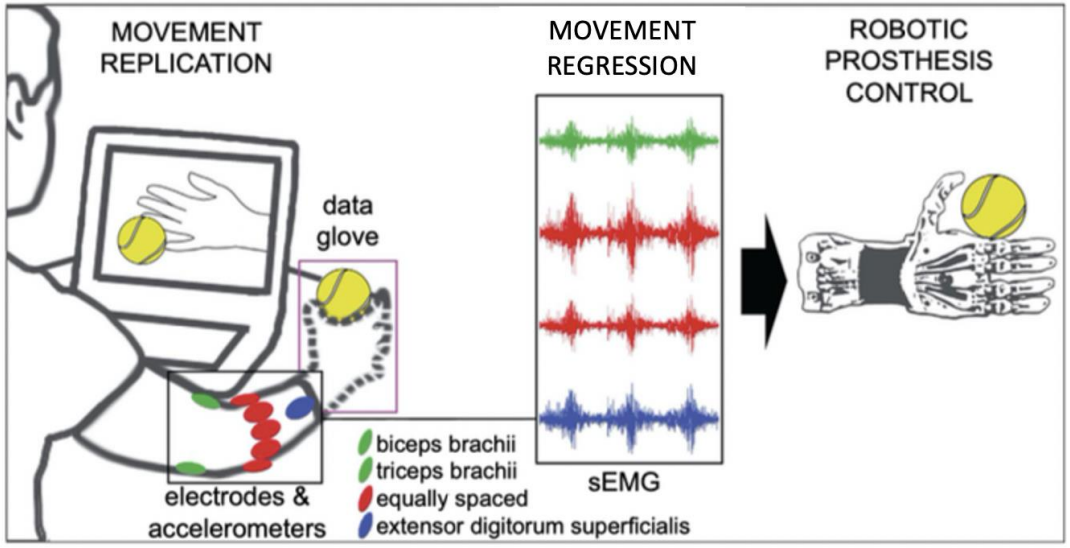
DEEP LEARNING FOR HAND PROTHESIS PILOTING

ANTOINE BENADY – RAPHAËL REME

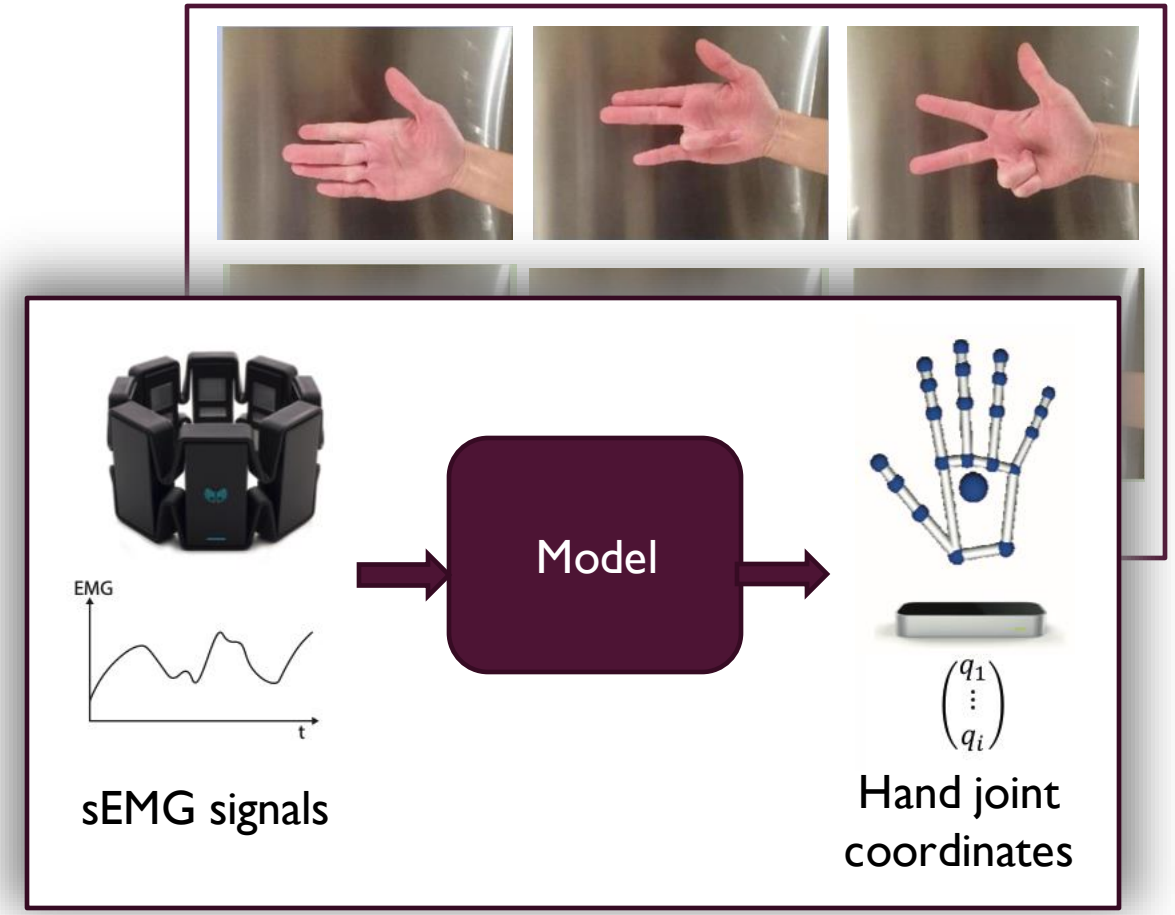
INTRODUCTION

- Active, handy and cheap hand prosthesis conception is still a challenge.
- The understanding of the user will is an active field of research
- Electromyographic sensors are considered as a promising way of capturing the intention of the users



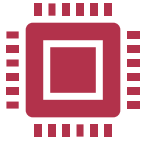
RELATED WORK : CLASSIFICATION VS REGRESSION

- First the problem was stated as a classification problem
  - Before deep learning : features extraction
  - The deep learning achieved similar results
- In 2018, research field started to state the question as a **regression problem**
  - Translating sEMG Signals to Continuous Hand Poses using Recurrent Neural Networks, Quivira et al. 2018
  - Regression of Hand Movements from sEMG Data with Recurrent Neural Networks, Koch et al. 2020



CONTENTS

Understanding the database



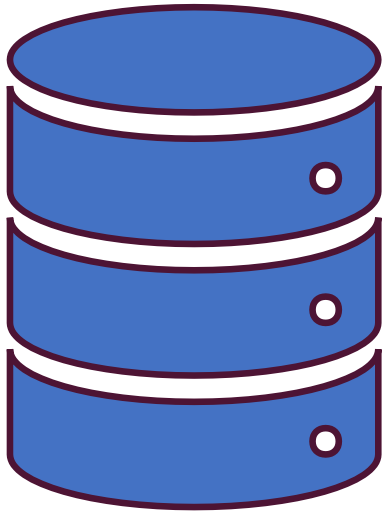
Pre-processing

Designing architectures

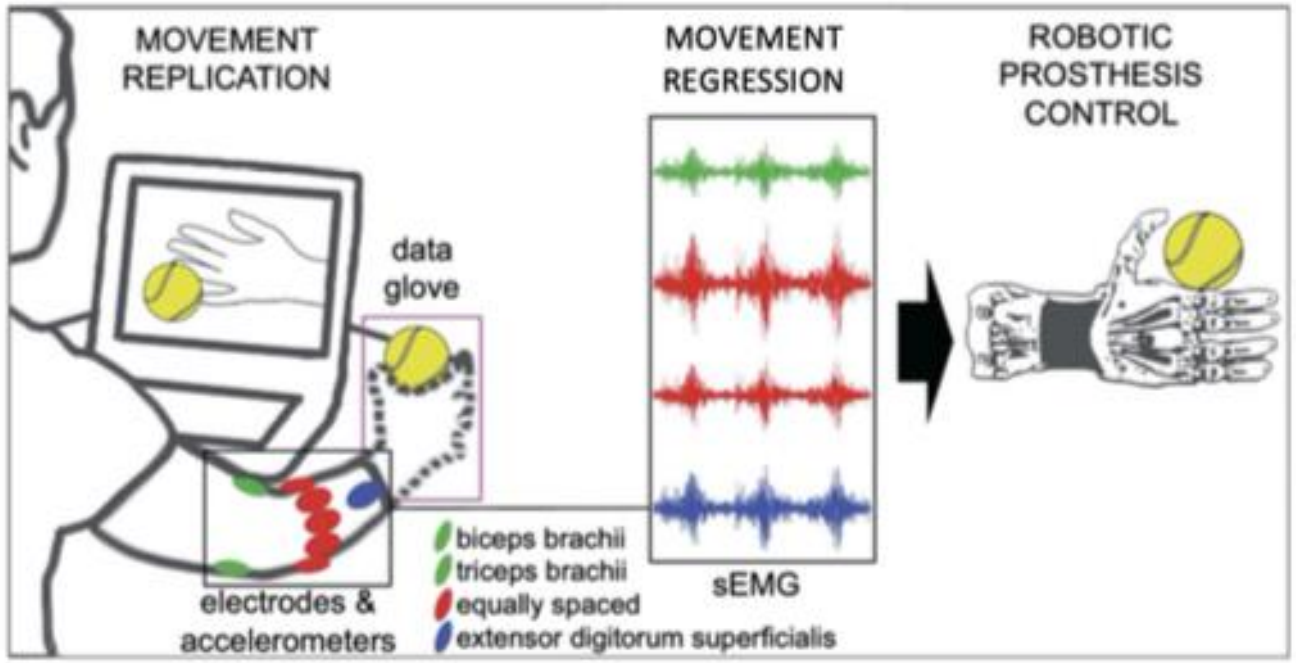
Training process

Evaluation & results

THE DATABASE

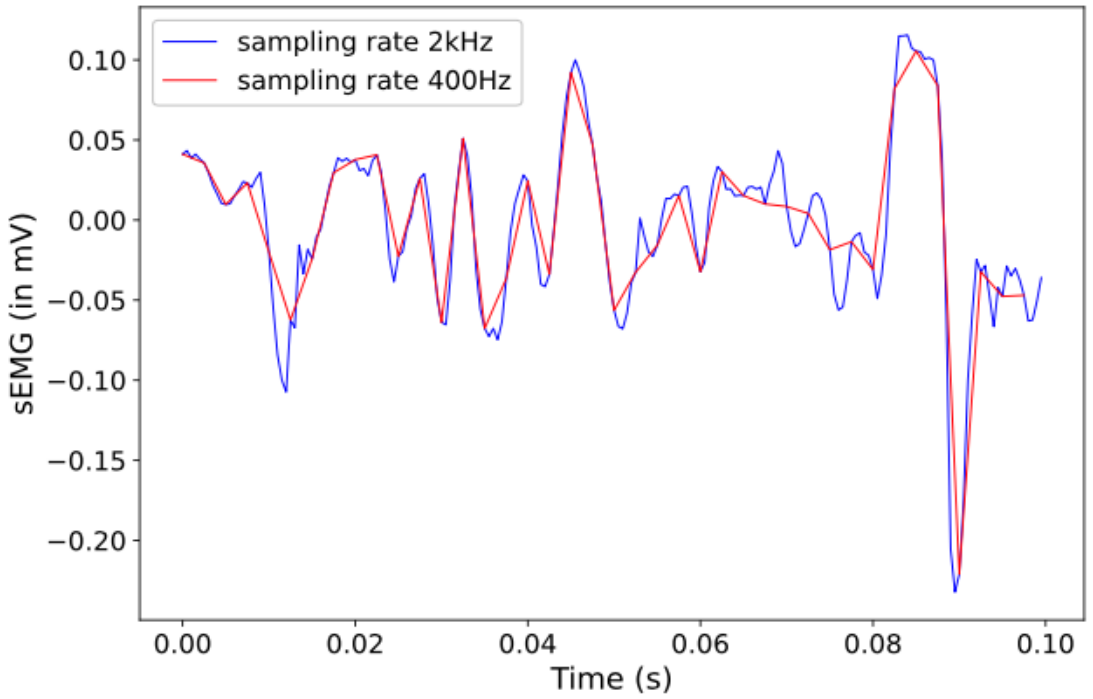


- Ninapro databases (in our case DBVII)
- 33 Gb of datas
- 20 subjects are asked to reproduce motion they see on a screen



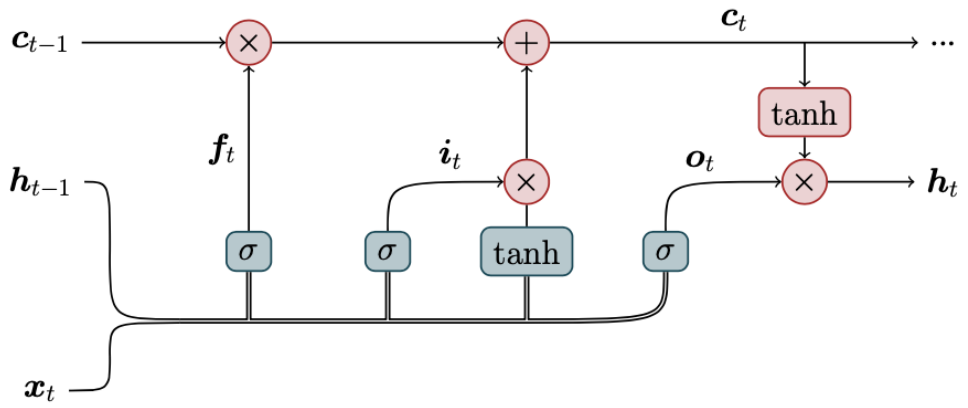
PRE-PROCESSING

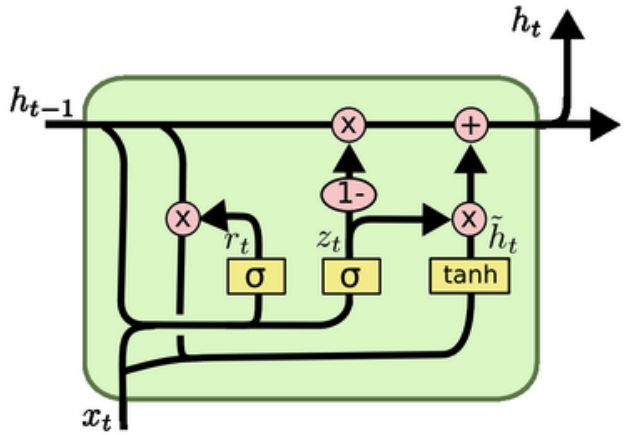
- Sub-sampling : from 2kHz to 400Hz
- Splitting the database in training, test, and validation
- Standardization or normalization of the input data



ARCHITECTURES

- We used two types of architectures :
  - One based on LTSM cells
  - One based on GRU cells





TRAINING PROCESS

- Batch of constant length sequences
- Classical loss for regression: MSE
- We noticed some issues using this loss and designed our own loss to solve them.

EVALUATION & RESULTS

- Mean Absolute Error such as in the literature

$$MAE(Y, \hat{Y}) = \frac{1}{n} \sum |Y - \hat{Y}|$$

- We did a lot of experiments detailled in the report such as :
  - Comparaison of GRU vs LSTM
  - Influence of the normalization / standardization
  - Influence of the loss function
  - Focus the training on one subject
- We achieve similar performances as some articles in the literature but we are still far from the best one

- Thank you for attention !