

1 Introduction

Goal: help this autistic guy

2 Problem Description

2.1 An hot Issue

2.1.1 Machine Learning for health

- Hope: better gathering of info, new knowledge
- Biological: genome decoding, immortality
- Company interested (Apple), National agency fundings
- Future Breakthrough for medicine

2.1.2 The case of Autism

- Under-construction scientific edifice
- Screening: 4 (worse for poor), 2, 1 in most case
- Earlier Screening = Better understanding of child need = Prevent the development of unadapted behaviors
- Why? Psychologist, shy, waitlist, expensive
- French people think, and they are right, that US health system is fucked up (and one can be skeptical about it to be improved by current government)

2.2 The Data

- How to design an app to screen for autism
- Videos trigger specific autistic behavior
- Tower fall, social referencing
- While playing the video on a tablet, we recorded the child reaction with the front camera,
- Data preprocessed into landmarks

3 General Approach

3.1 Face Analysis

- Why forgetting movement like "pointing finger"?

- Homogenous Data
- Beforehand on face expression = easy to reuse algorithm
- Smiling = Joy

3.1.1 Ideal pipeline

- Muscle contraction analysis to recognize instantaneous feelings
- Analysis of those feelings to recognize behaviors
- Analysis of those behaviors to screen for autism
- Learning or Psychologist

3.2 Random Process Classification

- Extract muscle contractions
- Response when the mom call the child.
- Non-autistic: yaw = orienting his head = response
- Autistic: Not clear, random head move: difficulties to focus
- Time Series = Random Process Classification
- Specificity: multidimensional, not stationary (video event), particular distribution (mixture of different facial behaviors that can happen)

3.3 Behavioral Perspective

- At each frame, each channel (eyebrow motion, eyes opening) give a value.
- Correlation in time and in space = pattern recognition
- Pattern = simple action (crying, being amused)
- Word = BoW, Filtering = CNN,
- Harmonic Analysis scattering the spectral information (see texture classification)

4 Current Efforts

4.1 Characterization of Dynamics

4.1.1 Descriptors

- Easy descriptors: Density Estimation, Moment method, Histogram

- capture channel dependency: cross-moment, joint-histogram
- Correlation in Time (under construction soon, ideas under stationarity hypothesis)
- Non stationarity (detect it by hand? eg name response)

4.1.2 Machine Learning

- Too much features = Need for features selection (no idea yet)
- Implementation of SVM, NN, NN amelioration "metric learning"
- Test Procedure: cross-evaluation, or leave-one-subject-out

4.2 Behavioral Perspective

- CNN: everything to do, collaboration opportunity?
- Small dataset, Missing data
- Strong knowledge = constraint structure (some channel supposed independent)
- BoW = Same

4.3 Results up to now

- Results to beat: MCHAT (eg. have you wonder if you child might be deaf?)
- AUC but truly max precision st recall = 1
- ie. While not missing the detection of any autistic, minimizing the fake alarm rate
- Results with simple descriptors
- Random prediction: mean .5, var .08, 10000 try = best 80 %

5 Further Reading

- Darwin for Jean Michel, very first to analyze face expression
- Take home message
- one month collaboration = add a paper in your published collection
- Especially CNN or BoW part