Quantifying atypicality in affective facial expressions of children with Autism Spectrum Disorders

Angeliki Metallinou¹ (metallin@usc.edu), Ruth B. Grossman²,³ and Shrikanth Narayanan¹

1. Signal Analysis and Interpretation Lab (SAIL), USC, Los Angeles, CA
2. Emerson College and 3. University of Massachusetts Medical School Shriver Center, Boston, MA

**Motivation**

- Facial expressions of children with ASD often perceived as ‘atypical’
- Quantify atypicality
- Motion Capture (MoCap) and advanced statistical analysis
  - Capture, analyze, visualize
- Computational approaches for new insights for autism

**Database**

- 37 children, ages 9-14
  - 21 ASD, 16 TD
  - Detailed ASD MoCap
  - 28 markers
  - Emotion Mimicry Tasks
  - 18 emotional expressions

**Functional Data Analysis (FDA)**

- FDA: a collection of statistical methods¹
  - Representation, analysis, exploring patterns
- Time series data represented as functions
- From facial marker data to functional data
  \[
  x_1, x_2, ..., x_T \rightarrow \bar{x}(t) = \frac{1}{T} \sum_{t=1}^{T} x_i(t)
  \]
- \(\varphi_k\) basis functions, \(c_k\) expansion coefficients
- Smoothing, better derivative calculation, fPCA etc.

**Global Expression Properties**

- Facial Movement Synchrony
  - Left-right and upper-lower face correlations
- Face and Head Motion Roughness
  - Higher order derivatives
    \[ M_j = \frac{1}{T} \sum_{t=1}^{T} |D^j_x(t)|, j = 1, 2, 3 \]

**Conclusions**

- Expression differences
  - More asynchrony for ASD group
  - More motion roughness for ASD group
  - More variability in expressive choices/behaviors for ASD group
- Such differences may account for atypicality impression
- New quantitative insights

1. Ramsay et al., Functional Data Analysis, 2005