



AI-Autumn School,
28 Oct 2022

EEG Analytics in early-stage Autism prediction

Abhijith Vasista

Center for Advanced Research and Excellence in
Autism and Developmental Disorders [CAREADD]

St. John's Medical Hospital,
Bangalore - INDIA

Background

Autism in DSM-5, ICD-10

- Social Communication
- Restricted, repetitive and/or sensory behaviors
- Characteristics from early childhood

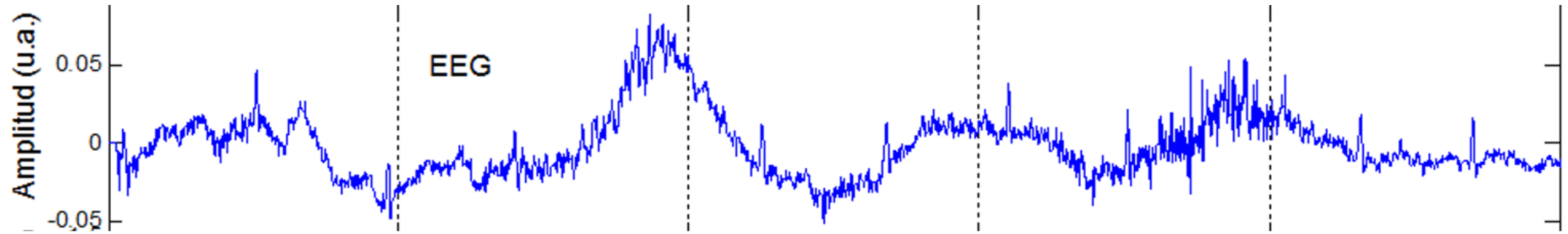
Risk Factors

- Obstetrics, Genetics, Nutrition, Environment,

Need of Computational Sciences

- Neurophysiology and Genomics precede behavior
- Early detection leads to early clinical intervention
- High Value attached to outcomes

Background



Areas of work

- **Characterizing** : Spectral features, Band Powers and ratios, Coherence, Connectivity, Causality, Fractals, RQA Analysis, Exponents from Chaos...
- **Detection & Prediction**: ML/DL models, Graph ML

Opportunities

- Experimental designs to establish/validate fundamental theories
- Small samples, high functioning subjects – low generalizability
- Inconsistent results especially Functional Connectivity Analysis
- Pursuit of accurate representation derived from EEG
- Evolving tools and methodologies
- Gap in state-of-the-art AI and application in Computational Biology

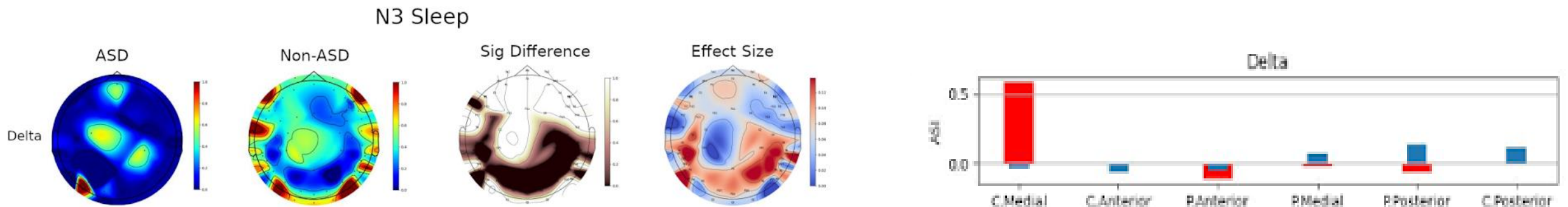
Sleep Study in ASD

- Pragmatism
- Qualitative measure of sleep disorders.
- Dysregulation of HPA-axis
- E/I Imbalance

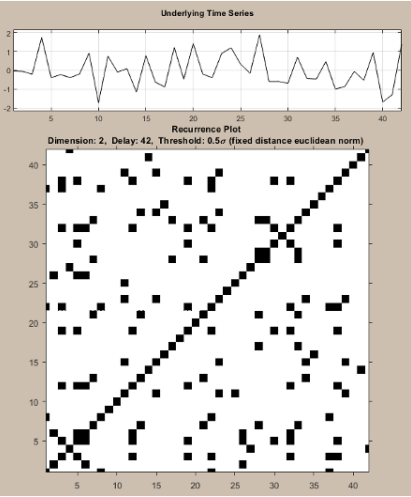
Resources

- 470+ EEG Recordings at inhouse Clinic, 64Ch, 1000Hz
- Preset Screenwatching **Awake + NREM Sleep** stages upto 3
- Clinical grade, artifact free, manually annotated by Neurologists
- Mixed bag of developmental disorders, mostly children & young adults

Results - Spectral Analysis



Results - Non-Linear Analysis



A.Vasista et. al., INSAR 2022

Non-Linear Parameters	Bands	States			
		Awake	N1	N2	N3
Recurrence Rate (RR)	Γ^*				
	Γ				
	β				
	α				
	θ	F3, T8			
	Δ	T8			
Determinism (DET)	Γ^*				
	Γ				
	β	T8			
	α				
	θ				
	Δ	F3, T7			
Lamininarity (LAM)	Γ^*	T8			
	Γ	F3, T7			
	β				
	α				
	θ				
	Δ				
Trapping Time (TT)	Γ^*	F7, T7, T8			
	Γ	Fz, T8			
	β				
	α				F3, F7, P3, Fp1, Fz, O2
	θ	P8, T8			P4
	Δ				
Entropy (L_entr)	Γ^*	F3, T8			
	Γ				
	β				
	α	O1, P7, T7, Fz	O2, P7, T7		
	θ				
	Δ				

Non-Linear Parameters	Bands	States			
		Awake	N1	N2	N3
Max Line Length (L_max)	Γ^*				
	Γ				
	β	F3, T7			
	α				
	θ	O1, P7, T7, Fz	O2, P7, T7		
	Δ				
Mean Line Length (L_mean)	Γ^*				
	Γ	T8			
	β	T7			
	α	F3, T7			
	θ				
	Δ				
Sample Entropy (SE)	Γ^*	F8			
	Γ	T8			
	β	F4, F7, T8			
	α				O1
	θ				
	Δ				P3, P8, O2
Detrended Fluctuation Analysis (DFA)	Γ^*				
	Γ				
	β				
	α				
	θ				
	Δ				

Evaluation of spectral EEG **Correlation Dimension** as an early-stage biomarker for autism spectrum disorders in awake and sleep states

A.Vasista et. al., ICCN 2022

- Low dispersion in N3 ASD
- Higher Anterior CD in N1, N2 ASD
- 36 Significant location between groups in N3

Inviting Collaborations !



- Multi-Centre studies carry high value
- Data & Expertise
- Build Tools & Technologies
- Science grows by knowledge sharing
- Joint grants
- Joint publications

