Detecting hypermotor seizures using extreme value statistics

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<u>Goal</u>: Detecting hypermotor seizures during nocturnal monitoring of epileptic children based on data collected from accelerometers attached to the extremities ➔ 3D acceleration vectors

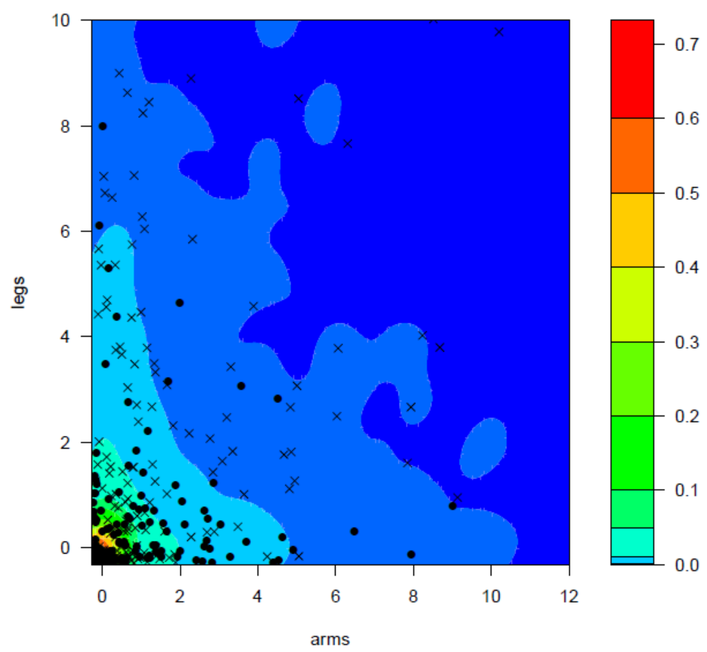
1 Seizure detection

- *Classical:*
  - Typical feature extraction as peak frequency, signal energy, spectral edge frequency
  - Supervised model inference e.g. Support Vector Machines
  - Indication whether movements are seizures or not is necessary (data annotation)

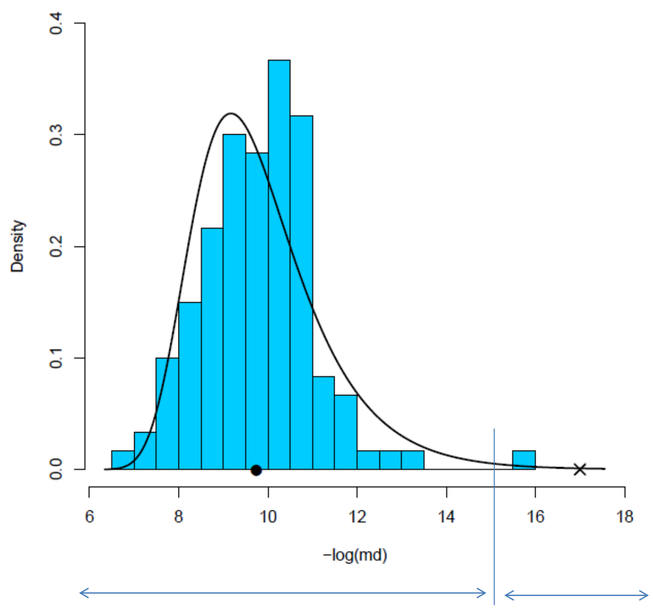
    ➔ Time consuming and expensive since data is patient specific
- *Our approach:*
  - Simple time domain features such as L_1-norm, L_2-norm, L_∞-norm and event energy
  - No annotation is required. Completely unsupervised!
  - Patient dependent model is easily estimated

2 Approach – 2D illustration

Modelling normal behaviour ➔ **Modelling minimal densities(md)** ➔ **Novelty scores**



Sample 1: ● Sample 2: x



Calculation as cumulative densities:

- Normal (●): <99%
- Abnormal (x): >99%

3 4D-RESULTS

- L2-norm as feature
- Each dimension = a limb

99%	ss	sp	pv(+)	pv(-)	auc
patient 1	1	0.833	0.857	1	0.975
patient 2	1	0.867	0.882	1	0.950
patient 3	1	0.829	0.854	1	0.990
patient 4	1	0.889	0.900	1	0.985
patient 5	0.5	0.800	0.714	0.615	0.817
patient 6	0.628	0.846	0.803	0.695	0.855
patient 7	1	0.881	0.894	1	0.974

4 Conclusions:

- In 5/7 patients: all seizures detected
- Number of false alarms is limited: Avg pv(+) of 85%
- Patient 5: only 1/2 seizures detected
- Patient 6, normal and abnormal behaviour less clearly separated ➔ Detection more difficult

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