

Rare event detection in healthcare using extreme value statistics

S. Luca^{1,2}, P. Karsmakers^{1,2}, B. Vanrumste^{1,2,3}

¹KU Leuven, Technology Campus Geel, AdvISE ²KU Leuven, Department of Electrical Engineering (ESAT-STADIUS)

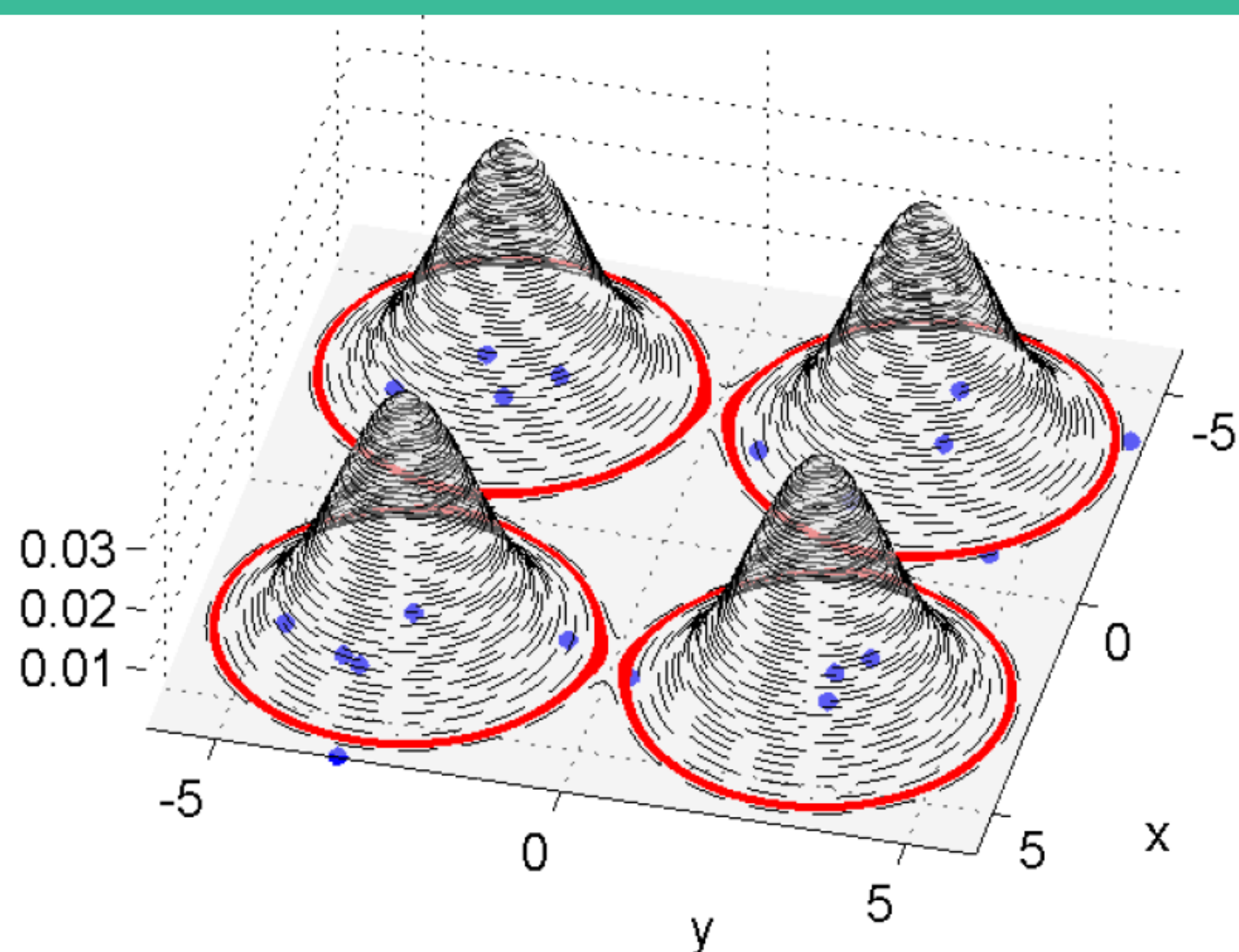
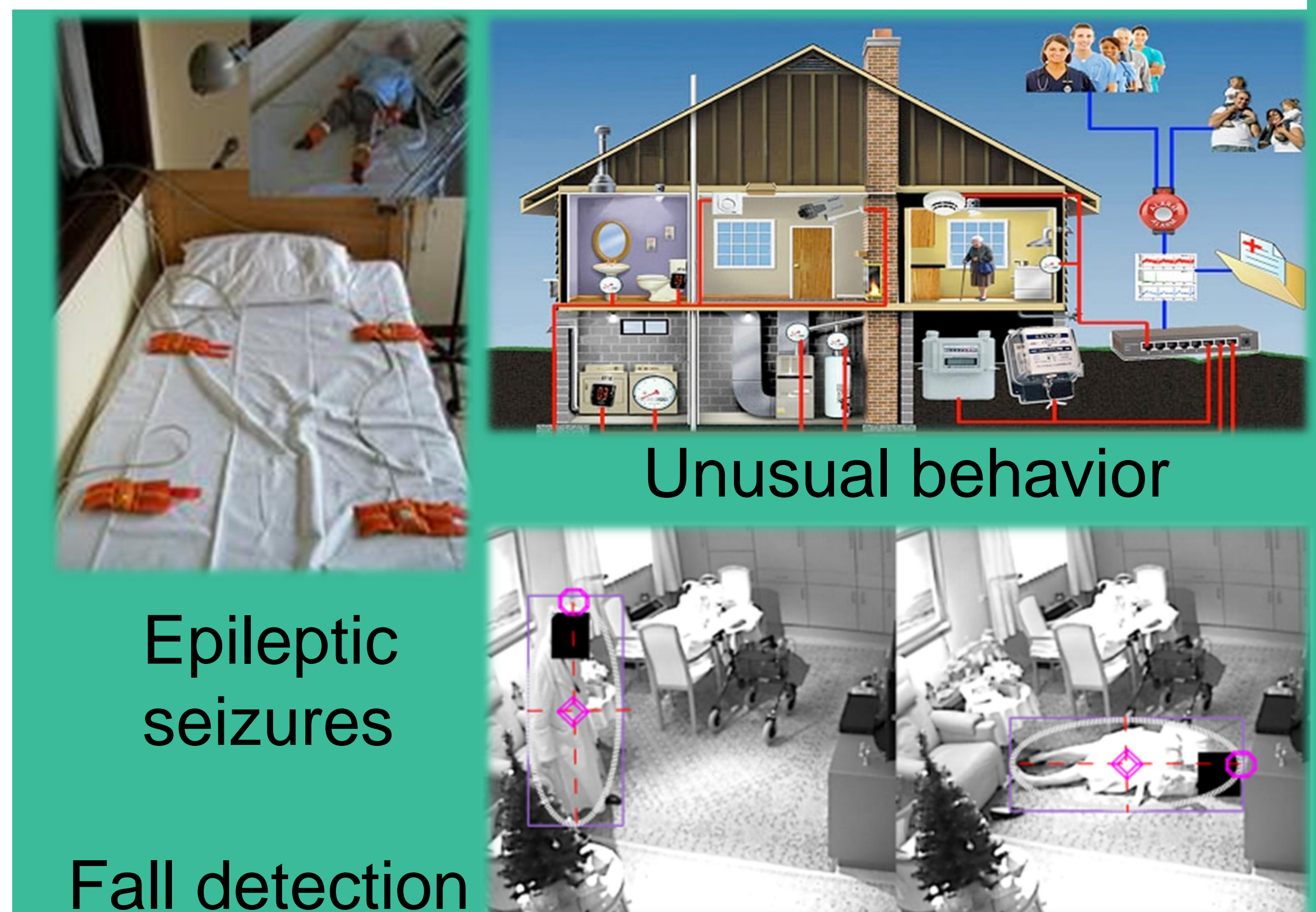
³iMinds Medical Information Technology Department

Rare events in healthcare

- Events occur very rarely in contrast to very well sampled data from “normal behavior”.
- Difficult to model with traditional approaches.
- Can be related to severe human consequences.

Our approach:

- No annotation of data is required.
- Patient specific model is easily estimated.



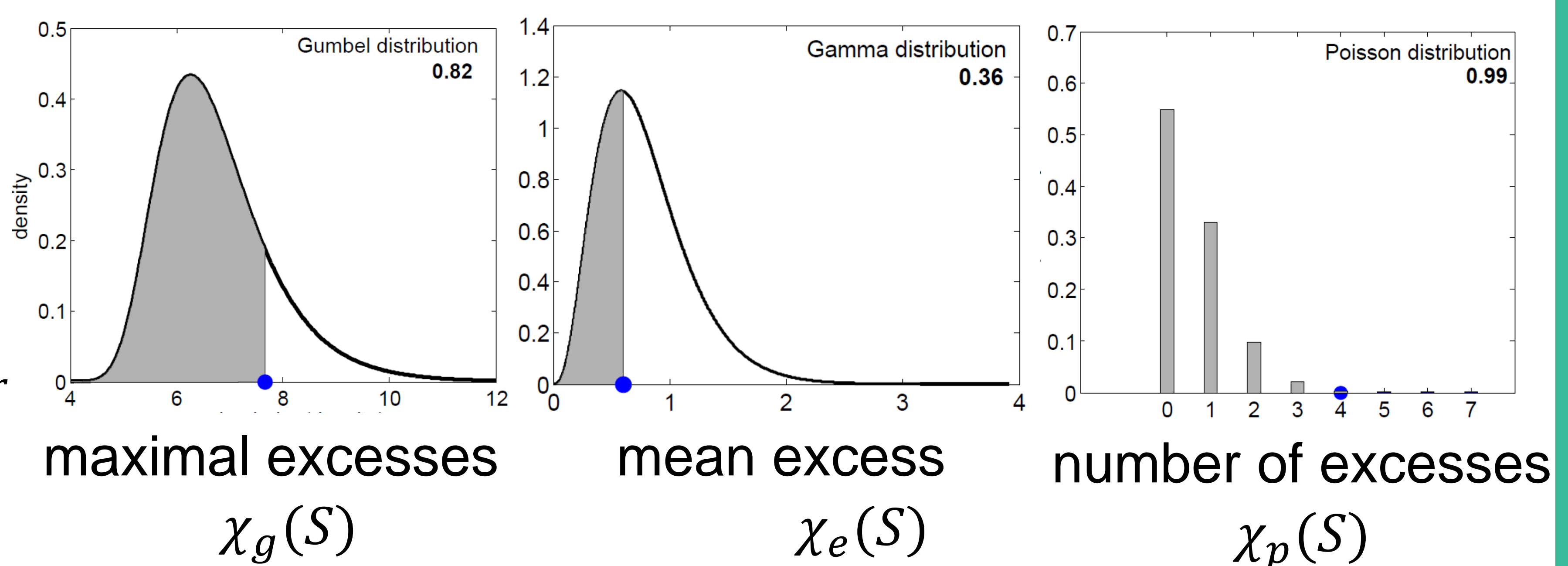
Sequence classification

- A multivariate random distribution X is used to model data related to normal behavior.
- Classification of a sequence of k data points $S = \{x_1, x_1, \dots, x_k\}$.
- Problem of multiple hypothesis problem for $k > 1$.

Extreme value statistics

Enables to combine cumulative probabilities of three types of models:

$$\bar{\chi}_r(S) = \left(\frac{\chi_g(S)^r + \chi_e(S)^r + \chi_p(S)^r}{3} \right)^{1/r}$$



Detection of epileptic seizures

Patient	Sensitivity		PPV	
	EVS	SVM	EVS	SVM
1	100	100	52.8	16.08
2	100	100	71.8	10.22
3	100	100	64.7	11.17
4	70	100	40.5	5.33
5	13.3	64.44	15.8	36.94
6	100	100	69.6	24.40
7	100	100	52.6	17.03

Conclusion

The number of false alarms can be reduced in comparison to an SVM approach by combining multiple types of information of a sequence.