

Transient analysis
- Method comparison -

Li&Ma tdep : reminder of the method

Compute significance:

$$L = \left(\prod_{t_i = (\Delta t, \dots, N \Delta t)} \frac{(\Delta t (b + s(t_i)))^{\{0,1\}}}{\{0,1\}!} e^{-\Delta t (b + s(t_i))} \right) \left(\frac{(b T_{OFF})^{N_{OFF}}}{N_{OFF}!} e^{-b T_{OFF}} \right)$$

product of the probability mass
function for each T_{ON} bin (0 or 1
event, for a large N)

probability mass
function for OFF
observations

$$TS = -2 \log \left(\frac{L_0}{L} \right)$$

$$\sigma = \sqrt{TS}$$

Li&Ma tdep : reminder of the method

Problem: optimize θ , the amplitude of the signal

$$s(t) = \theta f(t) \quad \text{with} \quad f(t) = t^{-1}$$

$$\frac{\partial \log L}{\partial b}(\theta) = \frac{N_{OFF}}{b} + \sum_{t_i \in t_{ON}} \frac{1}{b + \theta f(t_i)} - (T_{ON} + T_{OFF})$$

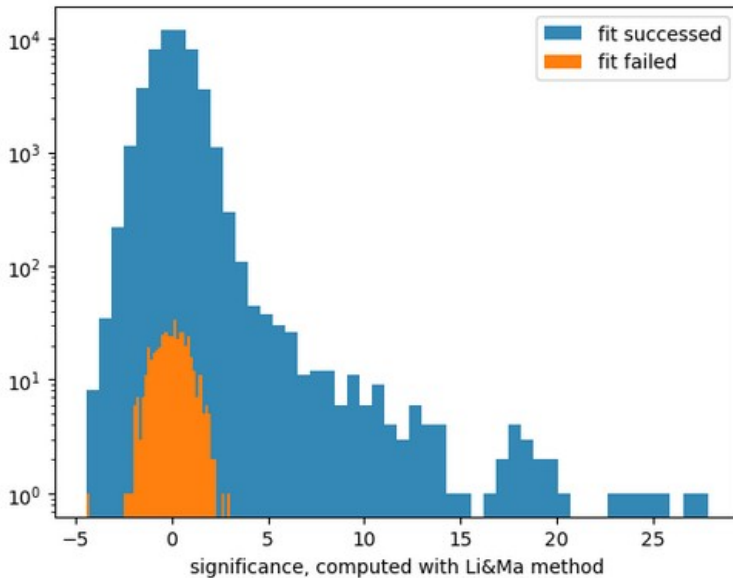
$$b = \frac{N_{ON} + N_{OFF} - \theta \int_0^{T_{ON}} dt f(t)}{T_{ON} + T_{OFF}}$$

→ use **Brent method** to find the root of the partial derivative and optimize the likelihood

Li&Ma tdep : optimization issue

Simulation: 50,000 sources

→ still ~0.8 % of the optimization fail



*Distribution of the significance for failed
and successful optimization*

Up to now : idk why there are still failings

→ more investigation needed

Maybe divergence of the signal amplitude ?

Spectral Temporal Fit : the method

Method: - base model → no emission

- source spectral model

- spectral temporal model

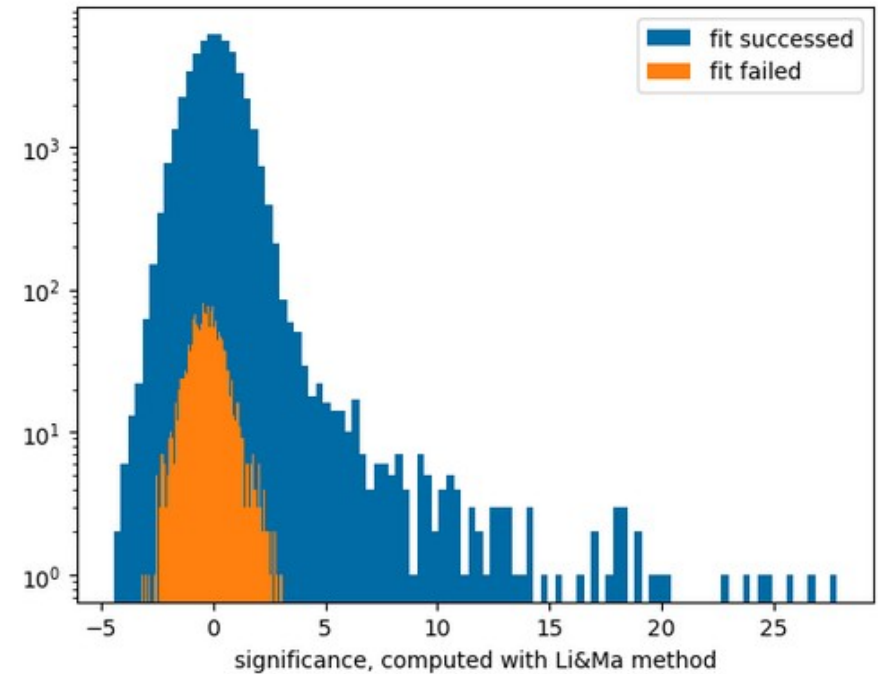
=> fit spectral model then temporal model with frozen spectral model

=> evaluate significance of complete model (spectral + temporal) vs base model

Spectral Temporal Fit : issues

Problem: fits not always working

→ ~10 % of the cases : complete fit fails
(5.5 % spectral , 4.9 % temporal)



*Distribution of the significance for failed
and successful optimization*

Spectral Temporal Fit : issues

Problem: high significance value

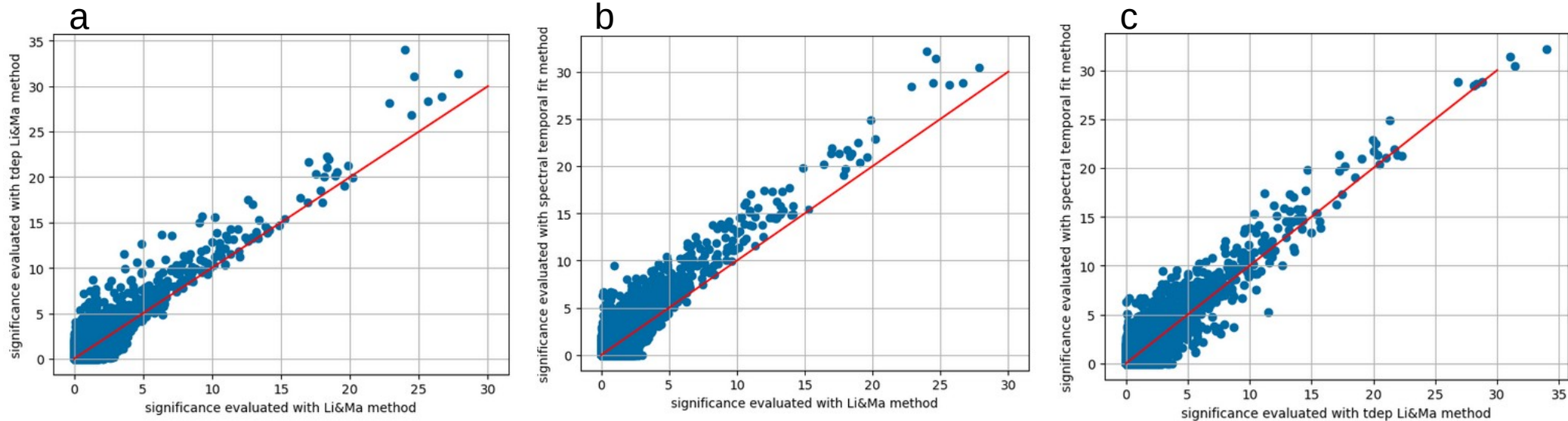
→ if significance $> \sim 34\sigma$

due to scipy function **erfcinv**, limit of float precision ($pval = 10^{-326}$)

=> limit of the method ?

Compare methods

Problem: 50,000 simulations



Plot of the significance computed with tdep (a) and spectral temporal fit method (b & c) depending on significance computed with Li&Ma (a & b) and tdep method (c)