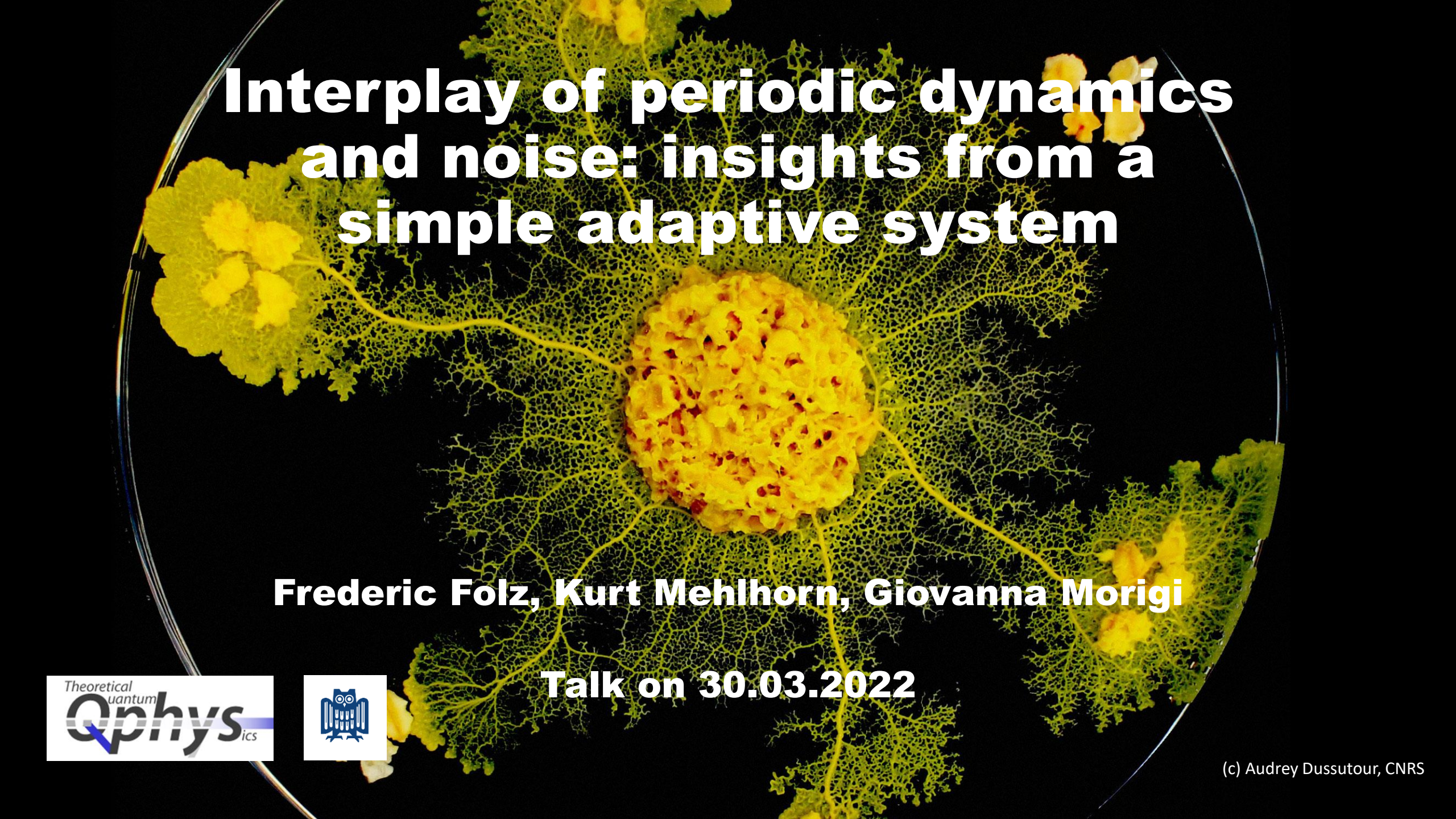


Interplay of periodic dynamics and noise: insights from a simple adaptive system

Frederic Folz, Kurt Mehlhorn, Giovanna Morigi

Talk on 30.03.2022

(c) Audrey Dussutour, CNRS

Food search

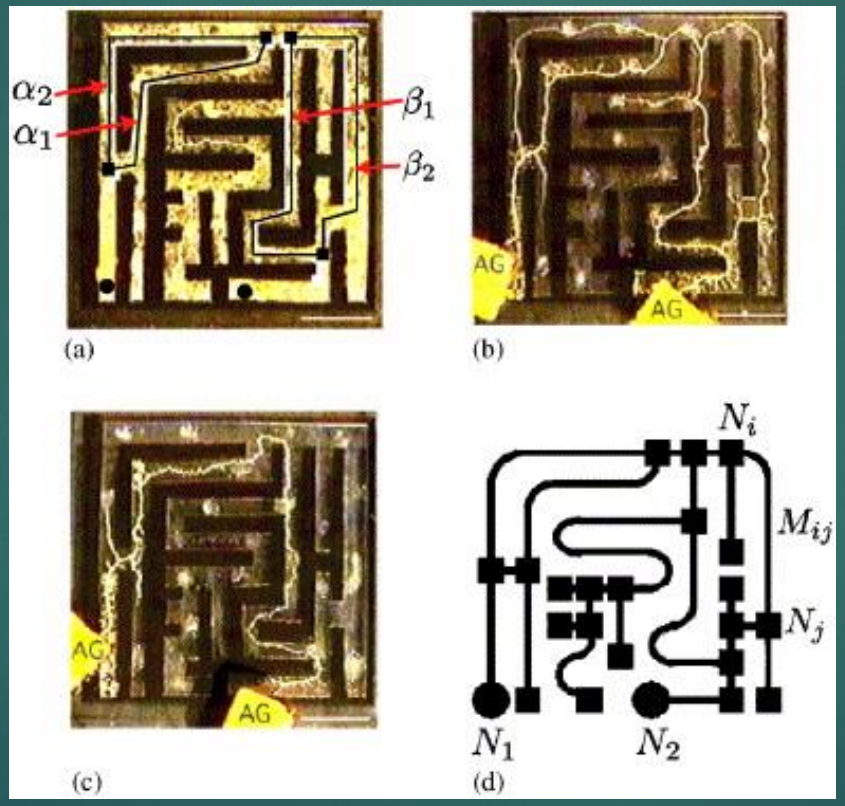
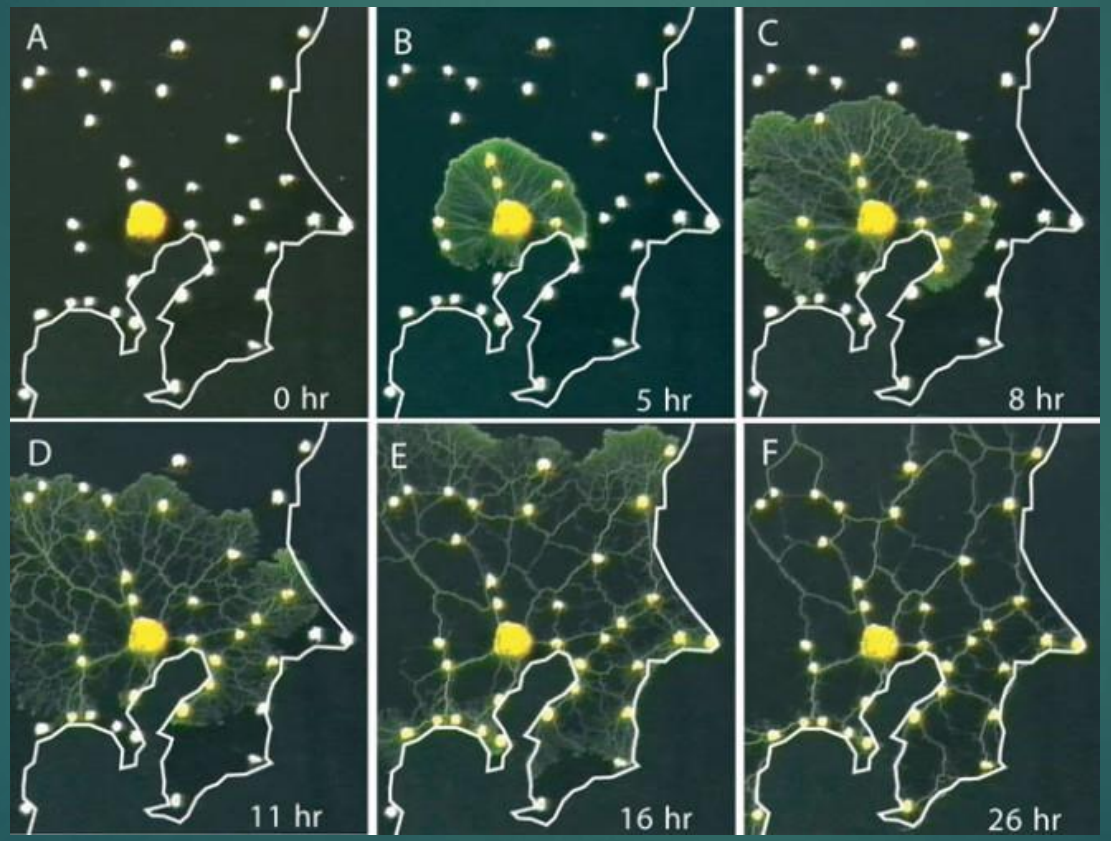


Fig.: Different steps in selection of shortest path.

Tero et al., Journal of Theoretical Biology, Volume 244, Issue 4, 2007, Pages 553-564

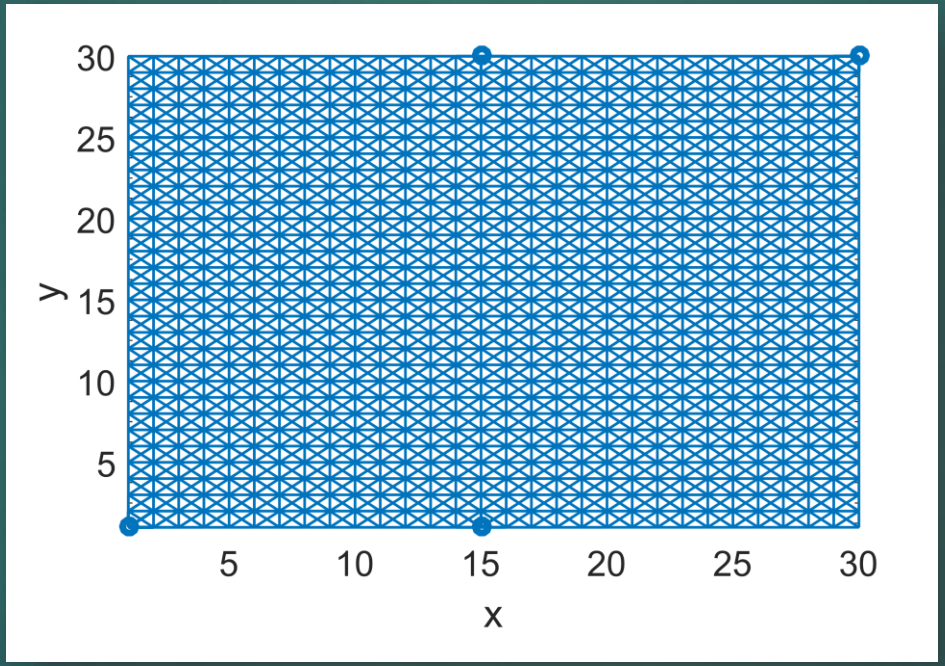
Tokyo railway network



Tero et al., Science, Volume 327, 2010, Pages 439-442

Fig.: Different steps in the formation of an efficient transport network.

Creating efficient transport networks



Creating efficient transport networks

- Flow of sol between neighboring nodes:

$$Q^i_{u,v} = \frac{D_{u,v}}{L_{u,v}}(p^i_u - p^i_v)$$

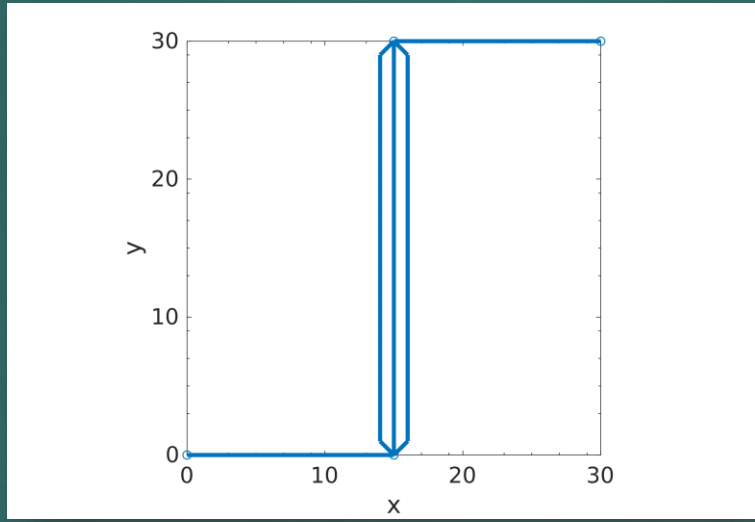
- Adaptation of tube diameter:

$$\frac{\partial D_{u,v}}{\partial t} = f\left(Q^1_{u,v}, ..., Q^k_{u,v}\right) - \gamma_{u,v}(t)D_{u,v} + \tilde{\alpha}\xi_{u,v}(t)$$

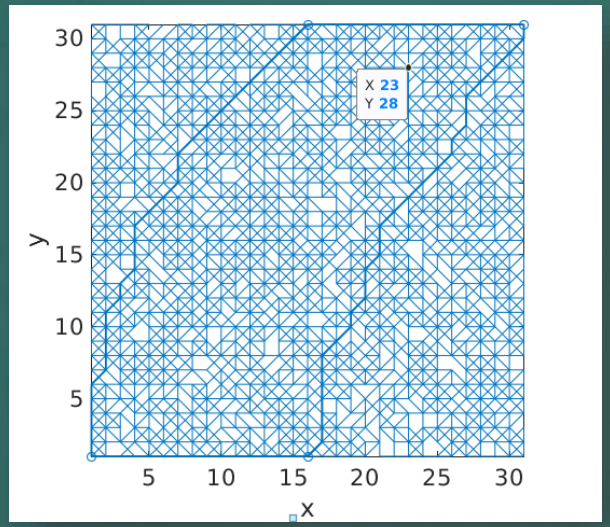
- Sol conservation:

$$\sum_{v \in E_u} Q^i_{u,v} = \begin{cases} 0 & \text{, if } u \text{ is a transit node of commodity } i \\ -I_0 & \text{, if } u \text{ is a source node of commodity } i \\ I_0 & \text{, if } u \text{ is a sink node of commodity } i \end{cases}, \quad \forall i \in \{1, ..., k\},$$

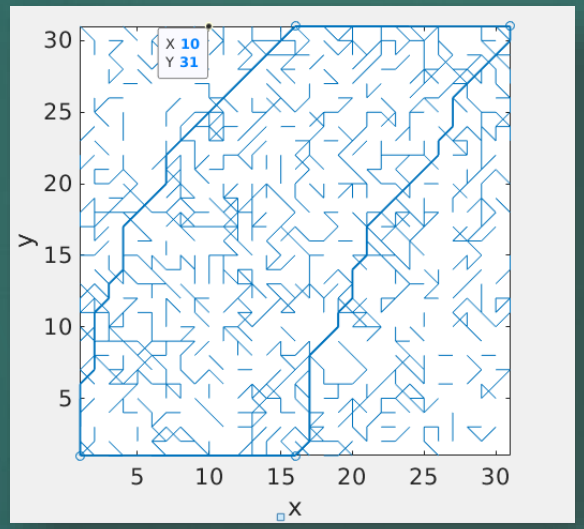
Creating efficient transport networks



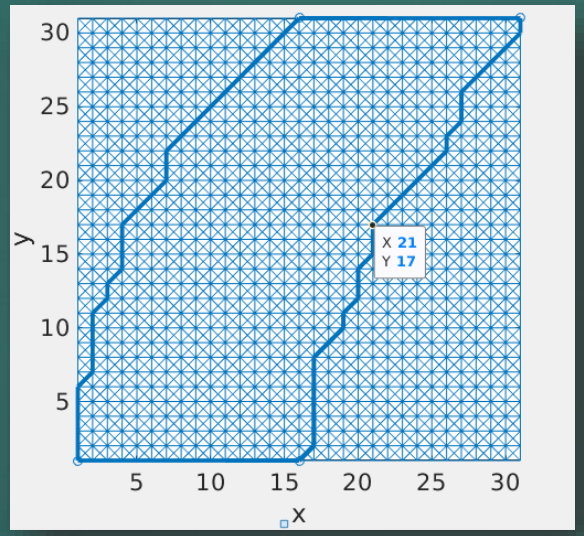
Creating efficient transport networks



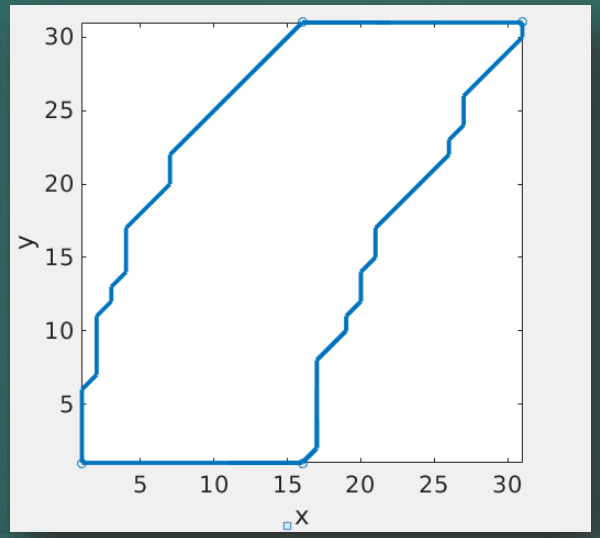
Creating efficient transport networks



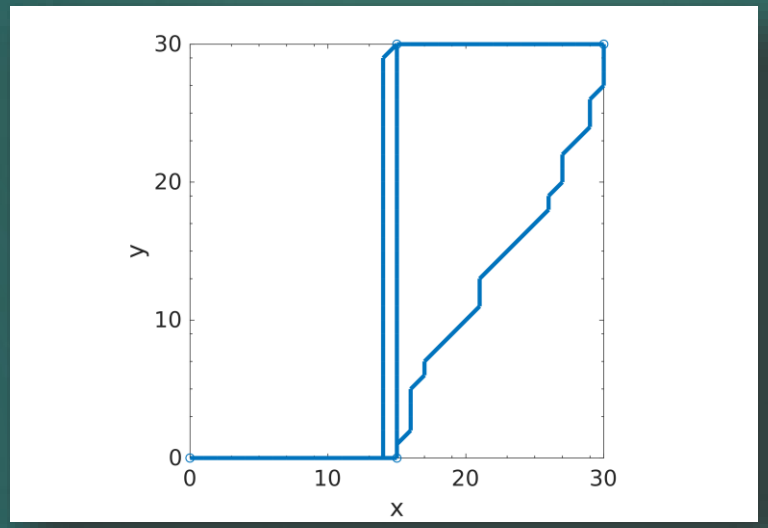
Creating efficient transport networks



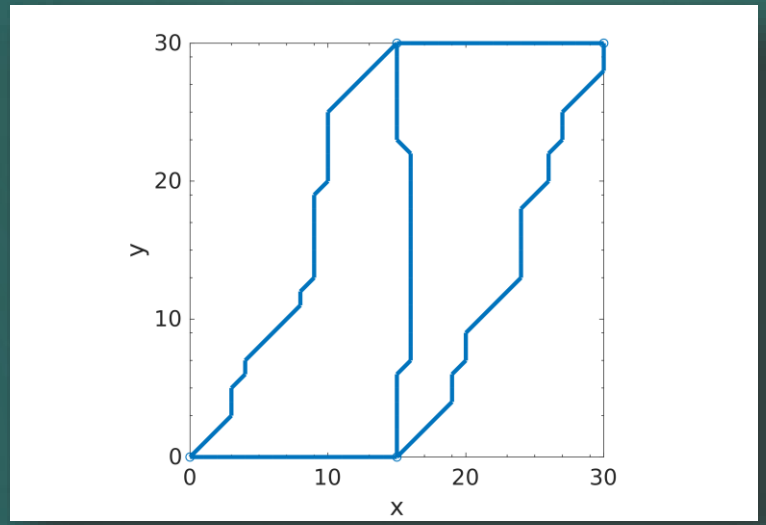
Creating efficient transport networks



Creating efficient transport networks



Creating efficient transport networks



Conclusion

- Slime mould creates efficient transport networks
- Noise creates new network topologies
- Disparity filter can be used to extract the network backbone