An adaptive agent-based model of homing pigeons: a GA approach

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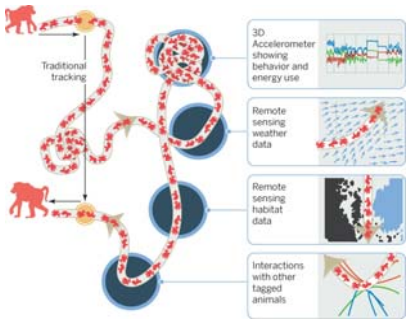
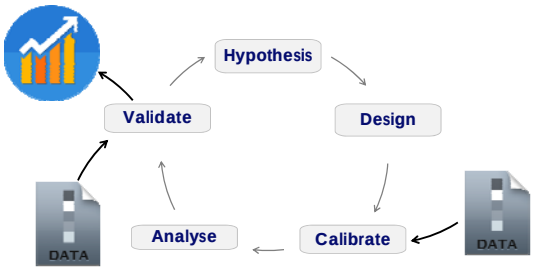
Big data is here

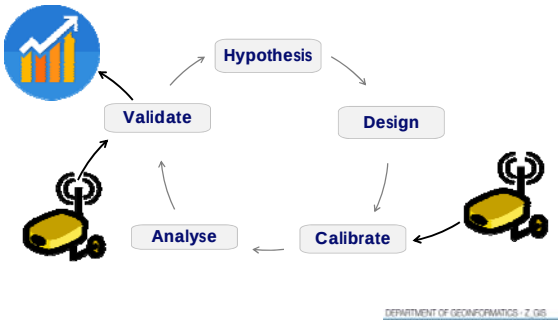


Kays, Roland, et al. "Terrestrial animal tracking as an eye on life and planet." Science 348.6240 (2015)

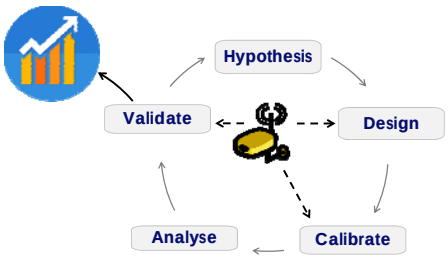
Conventional model cycle



Model-sensor framework



'sensor' data-driven



Research

- sensor observations : are dynamic, granular, real-time, 'ubiquitous'
- can sensor streams augment dynamic model specification (robust), calibration and validation? what about accuracy?
- which methods can we employ?
- what are implications to ABM in GIScience?

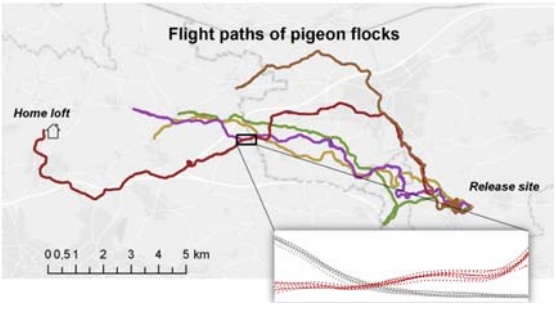
Approach

- sensor observations : emulated GPS trajectories
- dynamic model specification (robust) : by optimisation, dynamic evaluation and refinement of model parameters
- methods? Evolutionary (genetic) algorithms

Use case

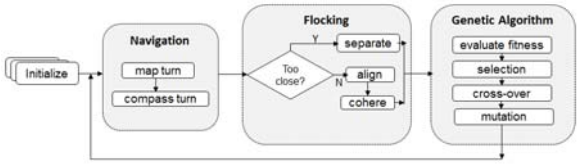
- Optimization of parameters to simulate adaptive navigation behavior of homing pigeons

GPS trajectories



Santos, C.D., et al., Temporal and contextual consistency of leadership in homing pigeon flocks. PloS one, 2014.

The model

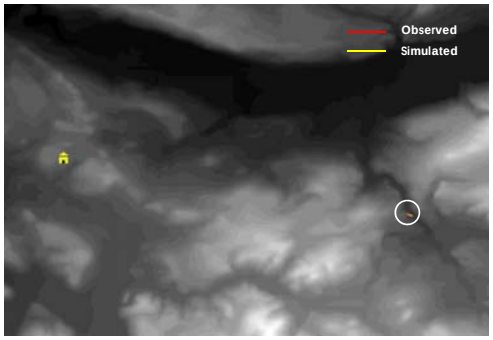


Chromosome of parameters

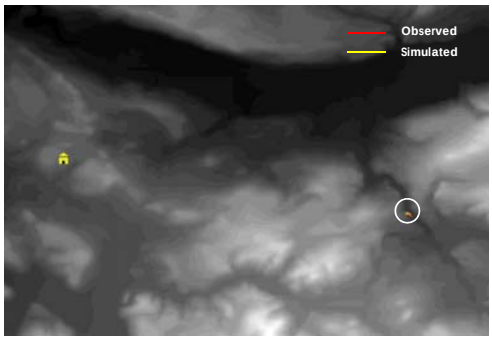
- **A conventional model** : calibrated to provide initial candidate parameters
- **Random noise**: introduced in each parameter to ensure uniqueness (stochasticity)

[illegible]	Cohere turn	[illegible]	Loft turn	[illegible]	Elevation turn	[illegible]	View angle	[illegible]	max step

Convetional model



Evolutionary model



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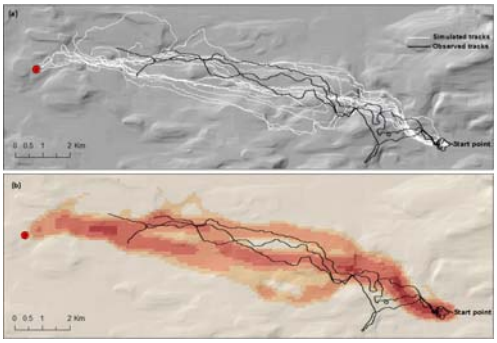
Results



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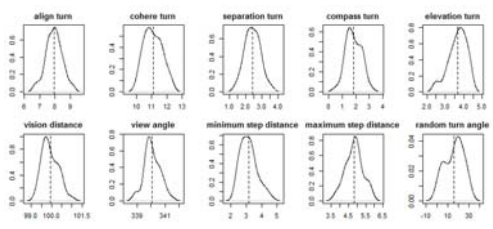
Optimized parameters



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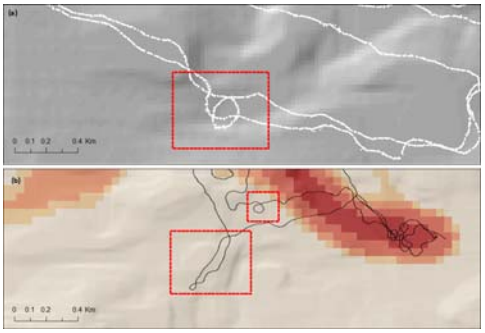
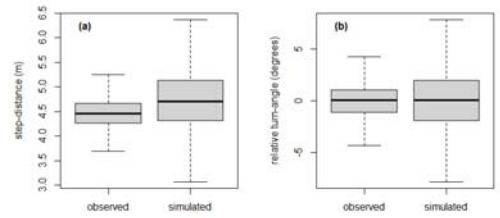
Patterns



Validation



Conclusion

- **Optimization** through evolutionary algorithm results in robust parameters
- Dynamic (sensor)data streams do **improve** specification of agent behavior and **validation** of models
- **Hybridity**: conventional + evolutionary
- **Epistemology**: Can data replace hypothesis?

Research directions

- Model-sensor interaction through educational robotics (bi-directional modelling)
- Dynamic behavior detection models
- Automatic rule-set (hypothesis) generation from sensor data streams