A model of urban evolution based on innovation diffusion

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Urban Evolution

Innovation diffusion

Research objective

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Research objective:

Model rationale

Model description

Model formalization

Model indicators

Model parameters

Parameter	Not.	Process	Range	Def.
Number of cities	N	Spatial scale	$10;100$	30
Initial hierarchy	α_0	System of cities	$0.5;2.0$	1
Initial population	P_{max}	System of cities	$10^4;10^7$	10^5
Simulation steps	t_f	Temporal scale	$10;100$	50
Growth rate	w_I	Pop. growth	$0.001;0.01$	0.005
Gravity range	d_G	Crossover	$0;2$	1
Innovation range	d_I	Crossover	$0;2$	1
Innovation rate	β	Mutation	$0;1$	0.5
Innovation hierarchy	α_I	Mutation	$0;2$	1
Innov. utility std.	σ_U	Mutation	$\left[0.7;2\right]$	1
Penetration rate	r_0	Mutation	$\left[0.1;0.9\right]$	0.5
Utility type	-	Mutation	{n;ln}	ln

$\rightarrow$ integration into the OpenMOLE model exploration open source software [**?**]

Enables seamlessly (i) model embedding; (ii) access to HPC resources; (iii) exploration and optimization algorithms

Synthetic configuration

Statistical consistency

Model exploration

Correlations

Model optimization

Discussion

Conclusion

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Open repositories for

- Model and results: `https://github.com/JusteRaimbault/UrbanEvolution`
- Simulation data: `https://doi.org/10.7910/DVN/IRHMQK`

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Reserve Slides

Model formalization

Macroscopic interactions

$$P_i\left(t+1\right) = P_i\left(t\right)\left(1 + \Delta t \cdot \left(g_i + \frac{w_i}{N} \cdot \sum_j \frac{V_{ij}}{< V_{ij} >}\right)\right) \quad (1)$$

where the gravity interaction potential is given by

$$V_{ij} = \left(\frac{P_i P_j}{\sum_k {p_k}^2}\right)^{\gamma_G} \cdot \exp\left(-\frac{d_{ij}}{d_i}\right) \quad (2)$$

References I