



## Posudek disertační práce

Uchazeč Vitalii Kostin

Název disertační práce Spatial Analysis in GIS for Sustainable Urban Form and Transport Development

Studijní obor Geodesy and Cartography

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### Aktuálnost tématu disertační práce

komentář: study of urban forms, the status and development of the road network and its influence to the urban development and sustainability are considered as important current topics both in urbanism and geomatics. The application of spatial analysis of urban forms in GIS brings new views and ideas how to quantify such phenomenas, how to evaluate and interpret them on both country-wide scale as well as in individual cities which has a direct impact to the urban planning.

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### Splnění cílů disertační práce

komentář: All objectives are fulfilled appropriate way. The summary of urban forms and structures is excelent from my point of view. More elaborated overview of spatial analysis and wider selection of relevant aspects, indicators and measures would be welcomed. Explanatory and descriptive analysis of networks at NUTS3 and LAU2 levels are crownd by good interpretation based on intimite knowledge of some specific features in individual cities' structures as well as deep understanding of indicators' behaviour. Gravity based accessibility measures were applied in 6 scenarios for 2 years for the whole country. Finally, evaluation and discussion of population changes, land use changes and land vulnerability for the Czech republic were provided. Results represent a valuable contribution from both methodological and applied points of view.

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### Metody a postupy řešení

komentář: Based on solid review of various existing approaches the author selects the preprocessing and transformation of road network into a graph and apply mainly methods of the graph theory, recommended for urban studies. They include mainly selected measures of graph centrality including several variants of nodality, densities of graph elements, beta index, graph diameter, Pi index, closeness, straightness, and the organic ratio. The dynamic modelling (according to the author) utilises one form of gravity based measure and a change modelling. The selected methods and their implementation are appropriate. The process of data selection and preprocessing should be more documented. More wider and deeper study of potential of methods and measures based on the graph theory (including accessibility studies) will be more beneficial.

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### Výsledky disertace - konkrétní přínosy disertanta

komentář: good overview of approaches to quantitative evaluation of urban forms and urban space, the novel approach to evaluation of road network using a set of graph based indicators, findings on indicator's behaviour and their relationships, gravity based accessibility evaluation of Czechia in 2018 and 2006, evaluation of land vulnerability as a result of transport accessibility and road network development pressure.

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### Význam pro praxi a pro rozvoj vědního oboru

komentář: important findings on behaviour of selected indicators which is important for the recommendation of appropriate, comprehensive as well as lean (the law of Parsimony) set of indicators/measures for evaluation of road network for its role in urbanisation, well prepared case studies for the Czech republic and an extended set of Czech cities which demonstrate the practical usefulness of such analysis for urban planning and sustainability development.

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### Formální úprava disertační práce a její jazyková úroveň

komentář: Superior. I do not remember when I read a thesis without any typing error and gramatic/logic issues (but I have to admit my only basic knowledge of English). The thesis are written in a nice, fluent style and even with a certain poetic accent on some places. The only comments refer to missing references on some places (some equations) and instabile and unsure terminology especially in graph terms (see bellow).

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### Připomínky

1. streets and roads are presented and measured namely as a link between an origin and a destination. But we do not forget about the role of public space and the street as a target of social activities like meetings, watching etc. The urban form evaluation is focused only on selected physical properties. What about methods for evaluation of demography and social dimensions? i.e. segregation measures. Also evaluation of urban form diversity and self-similarity may be applied. The selection of methods and measures should be more rich.
2. 33-34: original, but unsuitable 3 approaches to spatial analysis. Why to not use some of common classifications of spatial analysis? Generalization is not equal aggregation, aggregation is not specific for spatial analysis (see i.e. OLAP), as well as causative. A spatial analysis does not mean to deal with spatial data - the result must depend on spatial properties.
3. p.39: beware of MAUP and the scale dependency. The entropy (and many other measures) strongly depends on the scale.
4. p.39: missing knowledge of landscape metrics. Eq. 3 is wrong - minus is missing (this is Shannon's diversity index SHDI). In landscape metrics you will find many other suitable indicators, incl. Edge density, LPI, PSCV, Shannon Equity Index SEI, Interspersion and Juxtaposition Index, Fragmentation Index). on the contrary, location-allocation analysis cannot be included to measurements of urban forms.
5. p. 40-42: the description of fractals is too simple. D is frequently used for urban studies (Janoška 2011, Benguigui et al. 2000, Reynoso 2005). There are plenty of variant how to measure D. But it is not the only parameter of fractality. Where are fractals on fig. 15?

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6. uncertain terminology in the graph theory and all its implementation. It is impossible to arbitrary exchange vertex-nod-point, link-edge-segment.
7. Missing better knowledge of the graph theory. p. 46 - it is not a connectivity matrix but the neighborhood (adjacency) matrix. Using the adjacency matrix is not sufficient to describe a graph; better to use the incidence matrix (or relation) and the cost matrix.
8. 49-50, 74-75: there are many other potential measures of centrality (i.e. Eigenvector centrality, Katz centrality), but also other measures for structural equivalence and regular equivalence like local reciprocity, cluster coefficient) which may enrich static analysis.
9. p. 51: why to introduce a new classification of accessibility measures and not to use more appropriate existing one (i.e. Curl et al. 2011 or Geurs, de Wee, 2004)?
10. p. 53: spatial interaction models are just another name for gravity models. The difference is only in the form of calibration of distance-decay functions.
11. p. 55-56: beware of the space asymmetry. In such case (difference between travel results in opposite directions) your calculations become inconsistent.
12. p. 58-9: strange names of functions like gravity-type, kernel function. Both for gravity modelling and kernel estimations a set of various functions with different shapes is applied.
13. p. 64-69: both chapters 4.1 and 4.2 do not provide information about data and methods, but the background is prolonged.
14. p. 70: use the right English title "Czech Office for Surveying, Mapping and Cadastre" and abbreviation COSMC for ČUZK
- 15: missing full explanation and documentation of the selection, preprocessing data incl. parameters. I.e. year of CLC, what LC codes were selected, etc. p. 72: missing explanation of the graph implementation - what represent the graph nodes in your case study, what are edges?
16. the administrative delimitation of municipalities are not perfect for the graph evaluation. Results are influenced by the shape of artificial borders and non-urbanised parts inside.
17. p. 82: density of population will be more suitable for evaluation
18. p. 87: Pearson corr.coef. is not recommended to use
19. usage of the mean (arithmetic mean) for such asymmetrical distributions is not recommended
20. p. 96: České Budějovice - practically all streets in the centre are one-way streets. How does it correspond to the "high connectivity"?
21. fig. 55: the results depend on the size of municipality. A relative measure is required.
22. Pradhan (2017) - missing a full reference.

**Závěrečné zhodnocení disertace**

Autor prokázal předpoklady pro vědeckou práci. Připomínky k práci nemají zásadní charakter ve vztahu k naplnění definovaných cílů. Práce je přínosná a může nalézt rychlé uplatnění zejména v urbanistickém plánování.

Předložená disertační práce dokládá schopnosti autora k samostatné tvůrčí činnosti, splňuje požadavky kladené na disertační práci, a proto ji doporučuji k obhajobě.

Doporučuji po úspěšné obhajobě disertační práce udělení titulu Ph.D.  ano  ne

Datum: 5.5.2019

Podpis oponenta: 