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Development of a GIS-based planning process for grid interconnection

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Situation Analysis

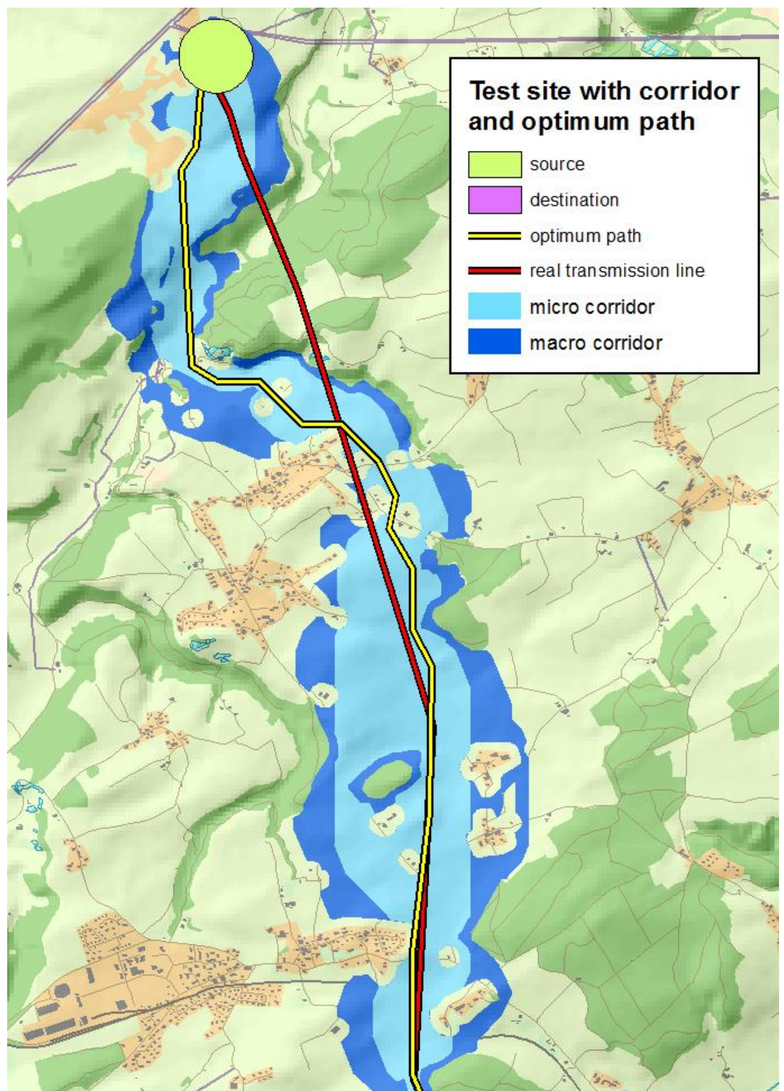
The current development of renewable energies and especially the expansion of wind energy lead to a difficult problem for urban planners and power grid operators: Wind parks are often built in remote locations where energy production is high but the required electric infrastructure is missing. Thus the interconnection to the existing power grid has to be routed through a complex and sensitive landscape. GIS software offers the possibility to analyse such diverse spatial relations and compute the optimum path. In this thesis a workflow is developed, that implements the transmission line siting methodology in ESRI ArcGIS 10.

Siting methodology

Spatial suitability analysis in the context of transmission line siting is a complex system of numerous conditions and spatial relations. Therefore, the decision maker specifies rules for the path finding algorithm by defining ratings and weightings. The single landscape features are rated according to their suitability and zones where traversing is not possible are defined as avoidance areas.

Implementation

The transmission line siting tool is implemented using ArcGIS 10 scripting capabilities and Python. The script features a graphical user interface for setting of user-defined parameters and an extensive workflow that converts input vector data to a cost surface using rating and weighting information. With the least cost algorithm, the tool generates the optimum path over this cost surface.



Tool output: Least cost path and corridors for test site in near Fribourg (Corminboeuf – Villarepos)

Additionally, complex electric calculations are executed by invoking the electric computation software OpenDSS.

Evaluation and Conclusion

A comparison of the software output with existing transmission lines shows that the calculated optimum path has both similarities and differences to the real transmission lines. On one hand, the path partially uses almost the same track as the real interconnection. On the other hand, the calculated path features too many curves. This is problematic because real transmission lines always tray to be as straight as possible. However, the evaluation shows that the tool provides valuable output, that the resulting path suggestions are meaningful and that the behaviour of the algorithm is comprehensive. Above all, the calculation time of only 10 minutes means an enormous time saving for the planning activities. By providing an optimum path suggestion and a corridor dataset, the siting process is already at a stage where detailed examination of alternative routes can be carried out.

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