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A new algorithm for least-cost path analysis by correcting digital elevation models of natural landscapes

Jieun Baek and Yosoon Choi

Pukyong National University, Department of Energy Resources Engineering, Busan, Korea, Republic Of (energy@pknu.ac.kr)

Most algorithms for least-cost path analysis usually calculate the slope gradient between the source cell and the adjacent cells to reflect the weights for terrain slope into the calculation of travel costs. However, these algorithms have limitations that they cannot analyze the least-cost path between two cells when obstacle cells with very high or low terrain elevation exist between the source cell and the target cell. This study presents a new algorithm for least-cost path analysis by correcting digital elevation models of natural landscapes to find possible paths satisfying the constraint of maximum or minimum slope gradient. The new algorithm calculates the slope gradient between the center cell and non-adjacent cells using the concept of extended move-sets. If the algorithm finds possible paths between the center cell and non-adjacent cells with satisfying the constraint of slope condition, terrain elevation of obstacle cells existing between two cells is corrected from the digital elevation model. After calculating the cumulative travel costs to the destination by reflecting the weight of the difference between the original and corrected elevations, the algorithm analyzes the least-cost path. The results of applying the proposed algorithm to the synthetic data sets and the real-world data sets provide proof that the new algorithm can provide more accurate least-cost paths than other conventional algorithms implemented in commercial GIS software such as ArcGIS.