▣ 博士學位論文紹介 ▣

논 문 제 목 : 교차로와 다른 구조물들을 고려한 도로선형최적화 모형 개발
(Modeling Intersections and Other Structures in Highway Alignment Optimization)

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Optimization of highway alignments aims to select the best alignment among many alternatives, based on specified objective functions and while satisfying various design constraints. Many factors should be considered in objective functions including structures, topography, land use patterns, environment, socio-economics, community concerns and even politics. Structures on highways include intersections, tunnels, bridges, grade separations and interchanges. Although structures can greatly affect the costs of alternatives, they have not been considered in previous alignment optimization models. Without considering structures, a model for highway alignment optimization would have very limited value and be unsuitable for any preliminary design applications.

This dissertation develops a model that can suitably analyze structures within the optimization processes. Its literature review classifies existing models, assesses their defects and identifies possible improvements. The characteristics of structures are then reviewed to clarify how structures affect selection processes. Cost function formulations, which are reasonably sufficient for preliminary highway alignment optimization but not for micro designs, are developed for structures. Several methods for enhancing the models applicability and flexibility are developed, including local optimization of intersections, detail intersection cost evaluation processes, planar and proportionally weighted interpolations for improving the precision of earthwork costs, a numerical search method for optimizing bridge spans, and a two-stage alignment optimization approach for improving both computational efficiency and quality of results. All developed methods are successfully embedded into existing genetic algorithms for generating, evaluating and searching the best highway alignment through the successive generations.

Various case studies to evaluate adaptability and applicability of the proposed methods are conducted using real GIS maps and artificial areas. The obtained solutions and sensitivity analysis for important parameters show that the developed methods can successfully find reasonable and acceptable solutions, thus overcoming serious weaknesses of existing alignment optimization methods that neglect intersections and other structures.