

## **Phase I Supplement: A MultiObjective Bilevel Approach to Highway Alignment Optimization**

### **Project Abstract**

This Small Business Technology Transfer (STTR) Phase I supplemental project is aimed at performing additional tasks for Phase I work in developing a multiobjective bilevel approach to highway alignment optimization. We have secured commitment for an external funding in the amount of \$100,000 from a Maryland based firm KM InfoTech, Inc. That funding will be used for marketing and product development purposes whereas the supplemental NSF funding will be used for performing additional research, especially in the bilevel and multiobjective areas to be able to develop a robust bilevel multiobjective optimization model for highway alignment optimization.

**Intellectual Merits of the Supplemental Work:** Bilevel approach is a fairly new approach in which dissimilar objectives, or constraints are separated at two levels. For example, in the classical vehicle routing problems with time window constraints a bilevel approach can be developed by first minimizing the delay at the lower level and then feeding that value to the upper level in which overall tour length is minimized. This iterative process is repeated until an optimum combination of lower and level objectives are achieved. This method is more robust than traditional way of imposing penalty for delays incurred in the single objective approach.

As part of Phase I research we have already developed a basic bilevel approach for highway alignment optimization in which user costs (such as travel time delay cost, vehicle operating cost, and accident cost) are formulated and optimization at the lower level, which are fed to the upper level in which agency costs (such as pavement, construction, and earthwork costs) are optimized. In this supplemental phase I work (Phase IB) we will further investigate the specific factors, such as traffic assignment, demand, etc. that are sensitive to the objective function components in the lower level. This will result in a better understanding of the bilevel optimization approach which may have applications on other problems, such as the vehicle routing problem. Therefore, the intellectual merit is in improved understanding of the bilevel approach.

**Broader Impacts:** The understanding of the bilevel multiobjective optimization will allow us to cost effectively plan and design highways while being sensitive to factors influencing road users (such as safety, mobility, and comfort) and environment. This will result in boosting U.S. economy since road transportation is vital to the U.S. economy. The bilevel multiobjective approach can also be applicable to other related areas as noted above.

**Key-words:** highway alignment optimization, highway route optimization, multiobjective optimization, bilevel modeling.

**Topic Name:** Information Technology; Subtopic: Human Computer Interaction-Representation and Visualization of Knowledge and Models (B2)