Cost Effective and Survivable Submarine Cable Path Planning

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**Abstract:**

The cable industry strives for cost effectiveness and risk avoidance in the path planning for submarine cables. We consider path planning of a cable between two points where the aim is to minimize construction cost and the likelihood of cable failure caused by hazards (natural and manmade hazards) and the costly consequences from such a failure (e.g. long duration of Internet shutdown). To achieve cable survivability, two approaches are adopted. One is to keep cables away from hazardous areas and the other is to use additional shielding for cable segments deployed in hazardous areas. These two approaches improve cable survivability but also increase cost. Our path planning procedure involves a multi-objective variational optimization, with two (conflicting) objectives: risk (potential repairs of the cables) and cost. We construct a model to describe characteristics of regional earthquake hazards, and to model the realistic surface topography as a triangulated manifold based on state-of-the-art geographic information science. Taking into account topography, ground motion information, and various other considerations and restrictions, we provide a methodology for cost effective design of a survivable planned cable path to obtain Pareto optimal solutions that, for a given risk (i.e. potential repairs), provides the cable path that minimizes budget, and solutions that minimize risk for a given budget. Using high quality real-world data and taking into account earthquake effects, the case studies are provided that show the effectiveness of our cable path planning method.

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