Method of Determining Optimal Laying Arrangement of Infrastructure Link

Communications & Information

Digital Broadcasting, Telecommunication and Optoelectronics

Opportunity

Critical infrastructures, such as oil, gas, and telecommunications, are essential to the functioning of the modern world, and infrastructural links are a crucial component. For example, submarine telecommunications cables carry >95% of global voice and data traffic, and Russian gas delivered through the trans-European pipeline supplies >25% of Europe's gas needs. Such links are vulnerable to damage during natural disasters, especially earthquakes, resulting in severely negative social and economic consequences. For example, an earthquake in Ecuador in 1987 damaged ~70 km of the trans-Ecuadorian pipeline, depriving the country of 60% of its export revenue, and repairs took 5 months. Similarly, the 2006 earthquake in Taiwan/Hengchun damaged eight submarine cables and disrupted Internet services across Asia for several weeks. These examples highlight the need to enhance the seismic resilience of critical infrastructure links, especially those crossing seismically active areas. The invention leads to an automatic tool that surveyors and planners can use as benchmark when they design infrastructure links.

Technology

The researchers have developed a novel method of automatically determining the optimal laying arrangement for a link between an existing infrastructure network and a new site. This method involves (1) modelling the terrain around and at a new site and the existing infrastructure network near the new site, e.g., as a surface; (2) modelling each factor affecting the link-laying arrangement as a respective cost (i.e., mathematical) function; (3) applying a weighting to each cost function to determine a life-cycle cost function; and (4) using the life-cycle cost function to determine an optimised link-laying arrangement with the minimal life-cycle cost from the new site to a connection point in the existing infrastructure network. The determined laying arrangement will help to minimise damage to infrastructure links, e.g., submarine cables and oil pipelines, during natural disasters, e.g., earthquakes, thereby decreasing socioeconomic impacts of disasters.

Advantages

- Efficient and effective planning of critical infrastructure link locations
- Increased resilience of critical infrastructure links to seismic and other natural disasters
- Enhancement of economic and societal resilience to natural disasters

Remarks

1. 49th International Exhibition of Inventions of Geneva (IEIG) (2024) - Bronze Medal

IP Status

Patent granted

Technology Readiness Level (TRL) ?

3

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- Reduction in repair costs

Applications

- Oil and gas producers and network companies
- Water producers and network companies
- Telecommunication suppliers and network companies
- Electricity producers and network companies
- Consumers and countries will benefit from enhanced infrastructural supply surety in the event of natural disasters