

Dynamic cable simulation for ropeway transport systems

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Long confined to mountain ranges and ski resorts, cable transport systems are increasingly adopted in cities. Due to their fluid traffic and reduced ground footprint, urban cable transports offer an alternative solution to tramways and buses, as well as a new market for industrials. While the design of new installations usually relies on static analysis, past incidents involving dynamic effects, together with a trend for higher cable velocity, calls for a dynamical understanding of these systems. Although critical for safety, the dynamic simulation of cable transports is sparsely tackled in the literature, and no software exists to simulate an entire installation.

In this presentation, we propose a finite-element formulation for the dynamics of an elastic cable, subject to contact and friction with supports and sheaves. The cable motion equations are derived using the Lagrangian formalism, while Coulomb friction is handled using the framework of second-order cone complementarity. Our numerical program involves a custom finite element implementation in Python that avoids the appearance of compressive efforts in the cable, [1], and relies on solvers provided by the Siconos platform [2, 3] to solve for friction forces. We present dynamical simulation results based on a real chairlift installation, demonstrating the interest of our approach to anticipate unwanted dynamic effects. We then discuss the considered perspectives for this software, including the use of inextensible cable elements and interior-point optimization methods to manage contacts with supports.

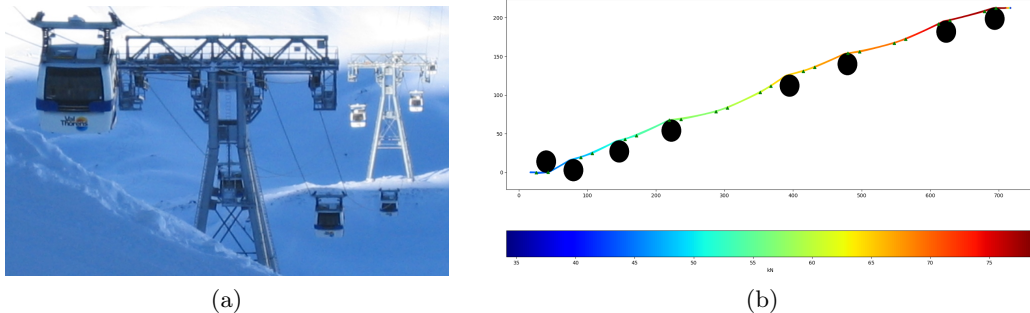


Figure 1: (a) Cable car installation in French Alps (source: Wikipedia), (b) Finite element simulation of an existing cable transport installation. The color bar represents the cable tension.

References

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