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The 2 Disjoint Shortest Paths Problem with Distance Constraints

An electric power supplier needs to build a transmission line between 2 jurisdictions. Ideally, the design of the new electric power line would be such that it maximizes some user-defined utility function, for example, minimizes the construction cost or the environmental impact. Due to reliability considerations, the power line developer has to install not just one, but two transmission lines, separated by a certain distance from one-another, so that even if one of the lines fails, the end user will still receive electricity along the second line. We discuss how such a problem can be modeled and prove the exact problem to be NP-hard. In addition, we demonstrate an approximate setting that allows us to solve this problem in polynomial time.