
Mixed Integer NonLinear Programming Models for the Delay Constrained Routing Problem

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1 Overview

We study mathematical models of the Delay Constrained Routing Problem (DCRP). The objective function is linear and consists of minimizing the total routing cost on all used links. We have one nonlinear "on/off" delay constraint per candidate path. This constraint must be satisfied if and only if the corresponding path is activated. This model allows also to set a maximum number of active paths for a given commodity. Ben Ameer and Ouorou showed in [1] that as soon as one considers two candidate paths per commodity, the underlying feasibility problem (ignoring the objective function) is NP-complete. We define the transmission delay through a link as a nonlinear function depending on the installed capacity on this link as well as on the traffic carried through. Given a set of commodities, a subset of candidate paths for each commodity, one should be able to route the whole demand by activating a subset of candidate paths with cardinality respecting the authorized limit and satisfying the delay constraints. This problem can be formulated as a mixed integer non-linear program including "on/off" constraints (see [2]). We propose four different convex formulations for this problem. A first model based on the work of Ben Ameer and Ouorou [1] using efficient Big-M quantities to translate the "on/off" delay constraints. The three other models, introduced by Hijazi and al. in [2], are based on relaxations of convex hulls in Disjunctive Programming. A set of 16 instances are solved using the Bonmin solver (see <http://www.coin-or.org/Bonmin>).

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