Point-to-Point routing formulation

N:	Set of nodes
A:	Set of arcs
P:	Set of parameters
d_{ij}:	Length of arc (i,j)
v_{ij}:	Vehicle speed on arc (i,j)
t_{ij}:	Travel time on arc (i,j)
x_{ij}:	Flow on arc (i,j)
c_{ij}:	Cost of traversing arc (i,j)
r,s:	Origin, Destination
θ_p:	Cost of parameter p
η_n^p:	Coefficient of v_{ij}^n for parameter p
φ_p:	Binary variable indicating inclusion of parameter p in the generalized cost function

To begin, authors introduce the network as a directed graph - $G(N,A)$, with set of nodes N and a set of arcs $A = \{(i,j); i,j \in N\}$. A vehicle traversing through this network observes costs pertaining to travel-related parameters $p \in P$, which manifest on the arc at a rate defined by a polynomial function on arc speed, given by, $\sum_n \eta_n^p v_{ij}^n$. Thus, the arc traversal cost is,

$$c_{ij} = \sum_{p \in P} \varphi_p \theta_p t_{ij} \sum\nolimits_n \eta_n^p v_{ij}^n \tag{1}$$

$$t_{ij} = d_{ij}/v_{ij} \tag{2}$$

Assuming deterministic nature of the network, authors formulate the point-to-point routing problem between origin node - r and destination node - s as a simple cost minimization problem,

$$\min_{x_{ij};\,(i,j) \in A} z = \sum_{(i,j) \in A} c_{ij} x_{ij} \tag{3}$$

Subject to flow conservation,

$$\sum_{i \in T(j)} x_{ij} = \sum_{k \in H(j)} x_{jk} \tag{4}$$

$$\sum_{j \in H(r)} x_{rj} = 1 \tag{5}$$

$$\sum_{i \in T(s)} x_{is} = 1 \tag{6}$$

$$H(i) = \{k; (i,k) \in A\} \tag{7}$$

$$T(i) = \{k; (k,i) \in A\} \tag{8}$$

Equation 4 balances incoming flow with outgoing flow for node j, while **Equation 5** and **Equation 6** balance flow at the terminal nodes, i.e., origin and destination. H, T are the node successor (head) and predecessor (tail) functions, respectively (**Equation 7** and **Equation 8**). This optimization problem is solved using the Dijkstra's algorithm (*25*).