A Bilevel Programming Formulation for modelling the location of Information Points for Traffic Conditions

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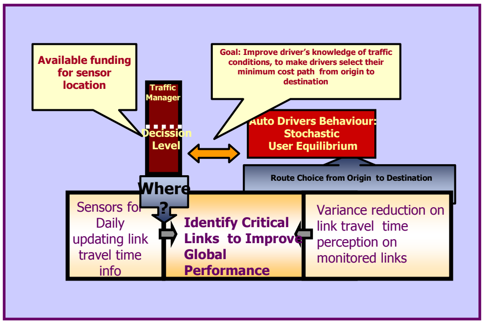
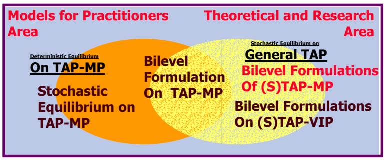


Transportation Planning Framework …



Bilevel Programming Formulation …

$$\min_x \quad \sum_{a\in\hat{A}} E[\mathbf{C}(\mathbf{v}(\mathbf{x}))^{\mathbf{T}}\mathbf{v}(\mathbf{x})]$$

$$\text{subject to} \quad \mathbf{x} \in \mathcal{X}$$

$$\mathbf{v}(\mathbf{x}) \in \mathbf{S}(\mathbf{x}) \qquad \mathcal{X} \stackrel{\text{def}}{=} \{\sum_{a\in\hat{A}} x_a \geq \delta;\ \underline{\gamma} \leq x_a \leq \overline{\gamma}\}$$

S(**x**) is the set of feasible link volumes satisfying stochastic user equilibrium parametrized by the upper level variables **x**.

- **The information of traffic conditions to drivers has as purpose the enhancement of the global quality of service for network users.**
- Quality of detection (and thus, information given to users) is postulated to directly affect the variance of the perceived link travel time random variable.
- A hierarchical decision-making problem of two levels is adopted in order to assess the allocation of information points.
- An upper level function that is the **system equilibrium performance** function and the lower level is an **Stochastic User Equilibrium Assignment Problem (STAP).**

Upper level: Minimization of the Expected System Performance
Variables: Coefficient to define link travel time variance on selected links
A predefined set of selected links, defined by traffic manager, candidates to sensor location

Variance redefinition on selected links

Stoch. Equil. Links flows and Perceived link travel time distribution

Lower level: Stochastic User Equilibrium Assignment Problem
Distribution of users according Stochastic User Equilibrium behaviour
MSA Algorithm and Monte Carlo simulation.

The decission process of allocating information points is ***heuristically*** attained by inspecting the optimal values of the upper level variables that should be interpreted as ***the influence of the quality of detection*** on the system performance function (upper level).

- The approach is static, in the sense that, no variation in time of the traffic conditions is considered

LOWER LEVEL : Stochastic TAP- Random Models for Link Travel Cost…

$$C_a \sim N(c_a, \sigma_a) \ \forall a \in \mathcal{A}$$

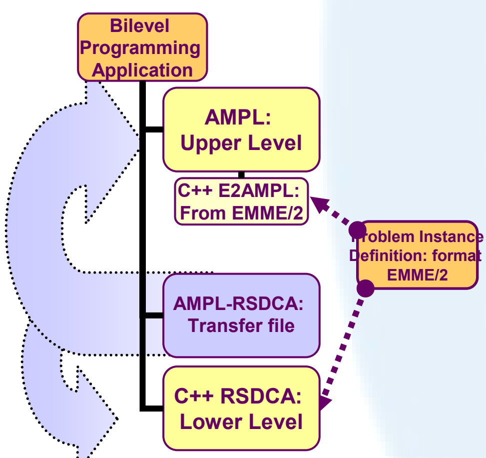
$$\sigma_a = \beta x_a c_a(s_a)$$

- **Expected perceived link travel time dependent on link volume (congestion dependent case).**
- **Additive models: route cost is addition of link costs defining the route.**
- **Expection of perceived link travel cost is measured link travel time.**
- **Variance of perceived link travel cost independent of link volumes:proportional to travel time on saturation**

MSA ALGORITHM FOR STOCH. TAP

- The Method of Successive Averages (MSA) with a predetermined step size was proposed by Daganzo (82) and Sheffi and Powell (82).
- MSA algorithm is a Monte-Carlo based method and does not required explicit path enumeration.
- MSA algorithm shows slow convergence, since it does not evaluate the objective function.
- Software Architecture fully developed.
- C++E2AMPL Interface operative.
- C++ RSDCA Environment operative.
- ***Upper level AMPL implementation of the Optimization Method is still on duty.***

Software Architecture



Preliminary Results and Conclusions

- Available the estimate by MonteCarlo of upper level function at x, ***expected system equilibrium performance function*** at v(x) .
- **System Performance function reduction when perceived link cost variance is reduced**

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