Optimal RErouting Strategies for Traffic mangEment (ORESTE)

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1. Associated Team ORESTE
2. Ramp-metering
3. Optimal re-routing
4. Perspectives
Outline

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ORESTE (Optimal RErouting Strategies for Traffic mangEment) is an associated team between Inria team ACUMES (ex OPALE) and the Connected Corridors project at UC Berkeley.

- Paola Goatin (PI)
- Maria Laura Delle Monache
- Guillaume Costeseque
- Alexandre Bayen (PI)
- Jack Reilly
- Samitha Samaranayake
- Walid Krichene
- Nikolaos Bekiaris-Liberis

Other fundings:
- ERC Starting Grant TRAM3
- France Berkeley Fund
ORESTE project goals

- Optimize traffic flow in corridors
  - ramp metering
  - re-routing strategies

- Modeling approach:
  - macroscopic traffic flow models
  - discrete adjoint method for gradient computation
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Numerical Results: case study

Figure: I15 South, San Diego: 31 km

\[ N = 125 \text{ links} \]
\[ M = 9 \text{ onramps} \]
\[ T = 1800 \text{ time-steps} \]
\[ \Delta t = 4 \text{ seconds (120 minutes time interval)} \]
Numerical Results

Density and queue lengths without control

Density and queue difference with control
Model Predictive Control

Performance under noisy input data: MPC loop

- initial conditions at time $t$ and boundary fluxes on $T_h$ (noisy inputs)
- optimal control policy on $T_h$
- forward simulation on $T_u \leq T_h$ using optimal controls and exact initial and boundary data
- $t \to t + T_u$

Comparison with ALINEA (local feedback control without boundary conditions)

Figure: Congestion reduction and noise robustness
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System Optimal Dynamic Traffic Assignment problem with Partial Control:

- Multi-commodity flow accounting for \textit{compliant} and \textit{non-compliant} users
- Full Lagrangian paths known for the controllable agents
- Knowledge of the aggregate split ratios for the non-controllable (selfish) agents.

Goal: Control compliant users to optimize traffic flow
Application to optimal re-routing

System Optimal Dynamic Traffic Assignment problem with Partial Control:

- Multi-commodity flow accounting for compliant and non-compliant users
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Goal: Control compliant users to optimize traffic flow
Numerical study: real case

Figure: I210 with parallel arterial route, Arcadia (13 km)

\[ N = 24 \text{ links} \]
\[ 1 \text{ hour time-horizon} \]
\[ \Delta t = 30 \text{ seconds} \]
Numerical Results

50% capacity drop between min 10 and min 30
Numerical Results

Arterial capacity used:

(a) 40% of arterial capacity  
(b) 50% of arterial capacity  
(c) full arterial utilization
Journal papers


Conference proceedings


PhD thesis

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3-years renewal just obtained for:
- General well posed junction models
- Variational approach based on Hamilton-Jacobi equations
- User equilibrium
- Lagrangian controls based on autonomous vehicles.

Members:
- **Inria**: P. Goatin, G. Costeseque
- **UC Berkeley**: A. Bayen, F. Belletti, C. Wu
- **Rutgers U** (partner): B. Piccoli, M.L. Delle Monache

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