

Optimizing traffic flow efficiency by controlling lane changes: collective, group and user optima (PPT)

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Optimizing Traffic Flow Efficiency by Controlling Lane Changes: Collective, Group and User Optima



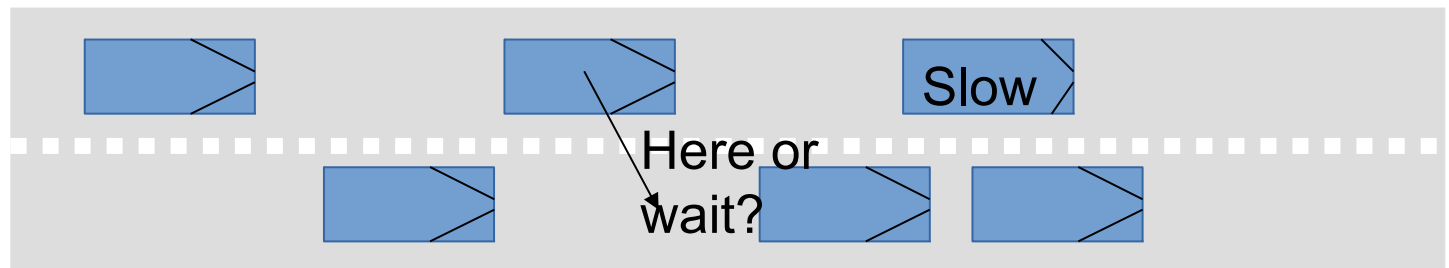
Shengyue Yao
Victor Knoop
Bart van Arem

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STW Project: Taking the fast lane
Presented at TRB Annual Meeting,
January 2017, Washington DC¹

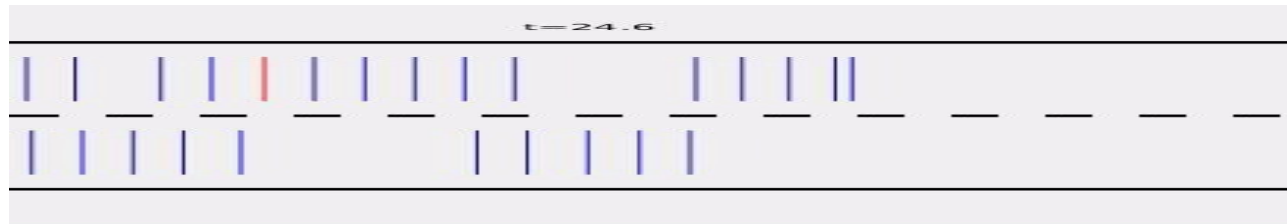
Contribution

- Connected vehicles can be sent instructions on lane change
- Optimize for best lane change instance
- User optimum, collective optimum, or group optimum:
 - Different lane change instanced
 - Different delays (and Braess-like paradoxes)



Problem description

- Two-lane simple network, fast lane & slow lane
- Bottleneck in the fast lane
- Controlled vehicles (5) change lanes to avoid congestion
- **Lane change instances optimized**



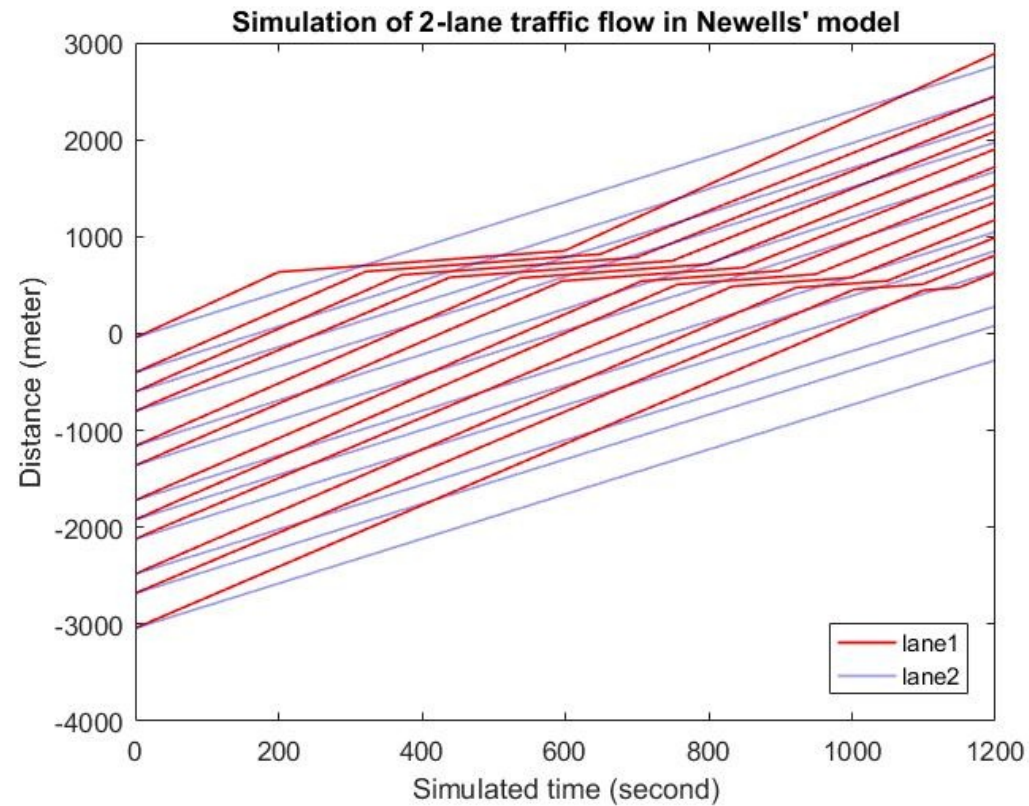
Three optima

- Minimize travel time
- Three different cases: minimize for
 - Collective travel time
 - Travel time of connected vehicles (i.e., group lane changing vehicles)
 - Individual travel time = user optimum
- Solve by genetic algorithm (Not possible in real time)
- Check properties of optimal solutions to learn from it

Simulations

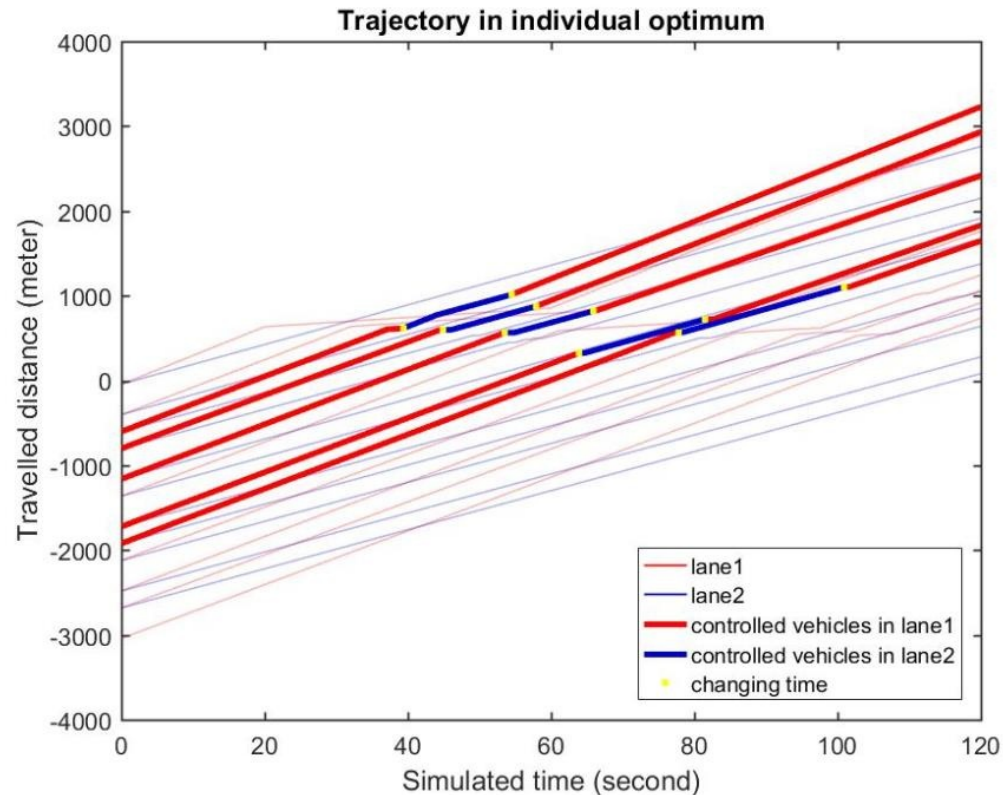
- Assumptions:
 - Point vehicles
 - Longitudinal: Newell's car following model
 - Lateral: no lane changes without instruction
- Leaving one lane = entering other lane

No control



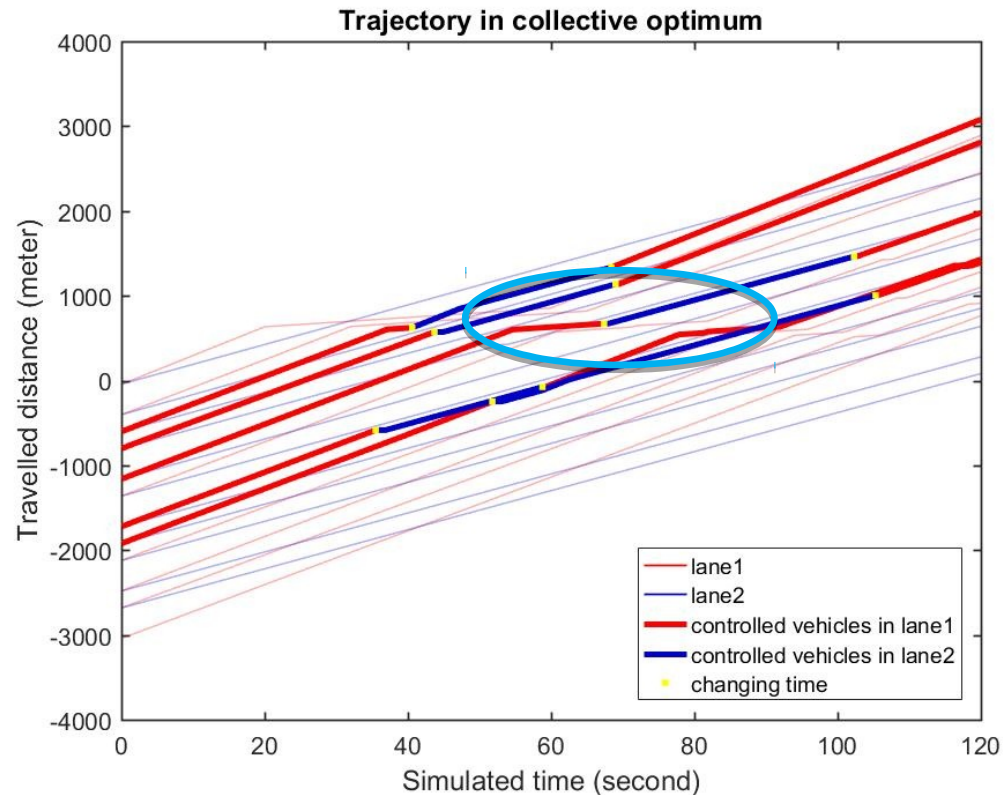
User optimum

- Drivers pass the slow moving area and change back



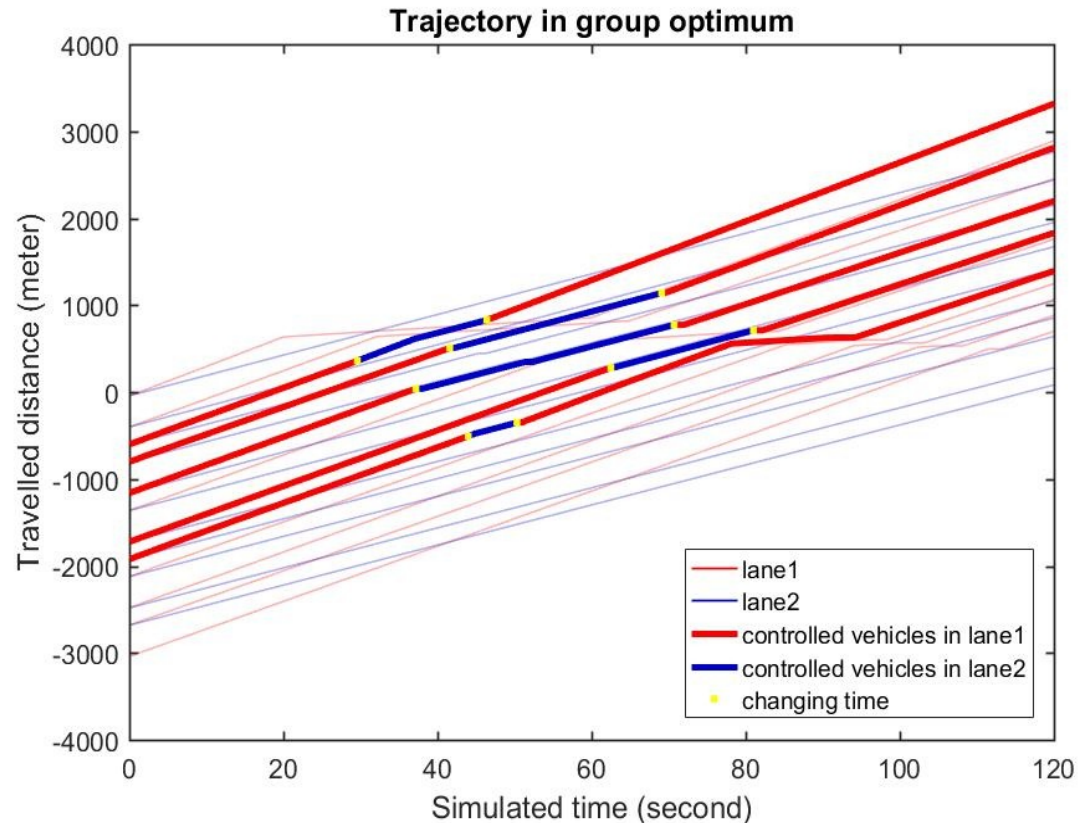
Collective optimum

- Lane changes into the voids

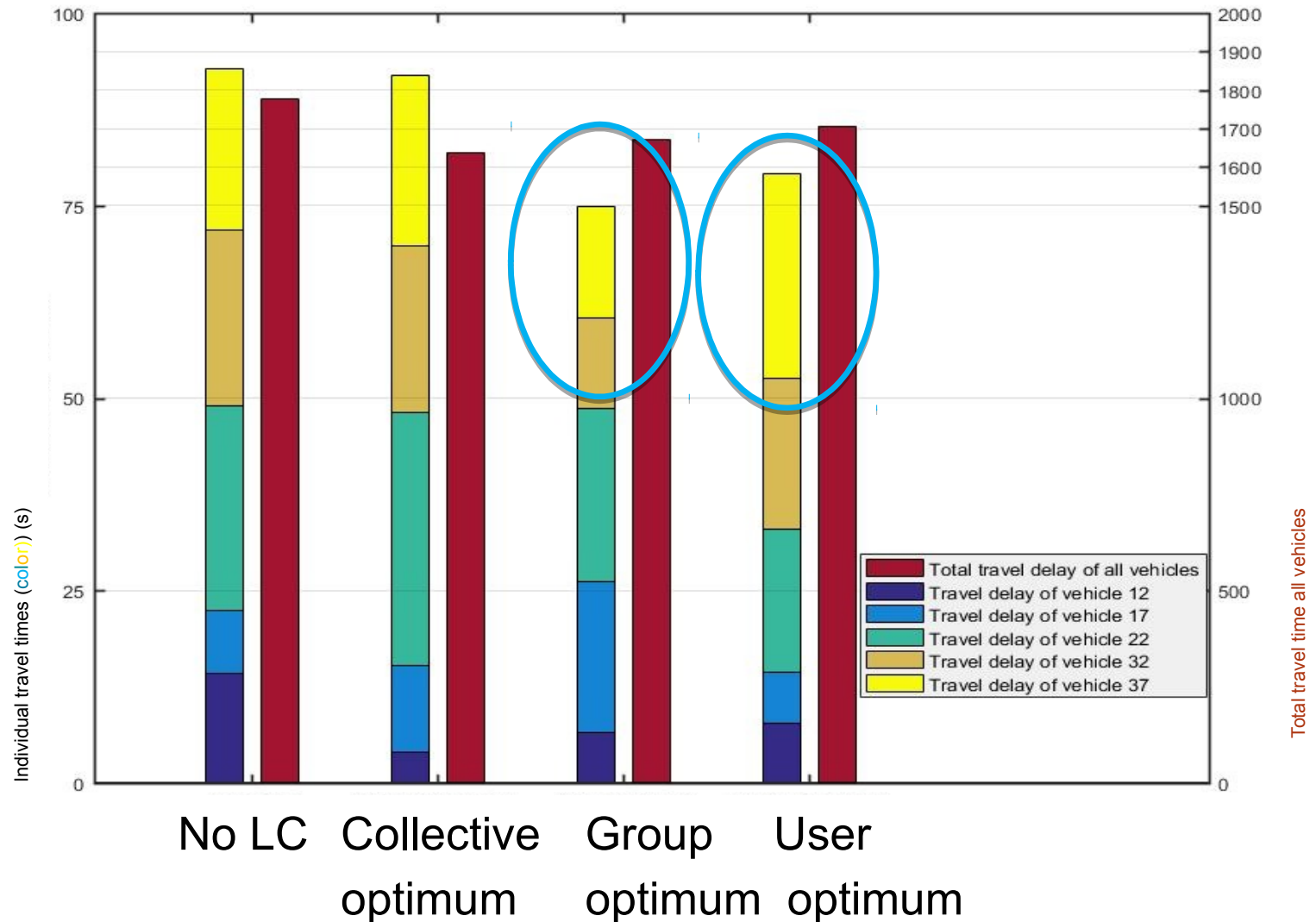


Group optimum

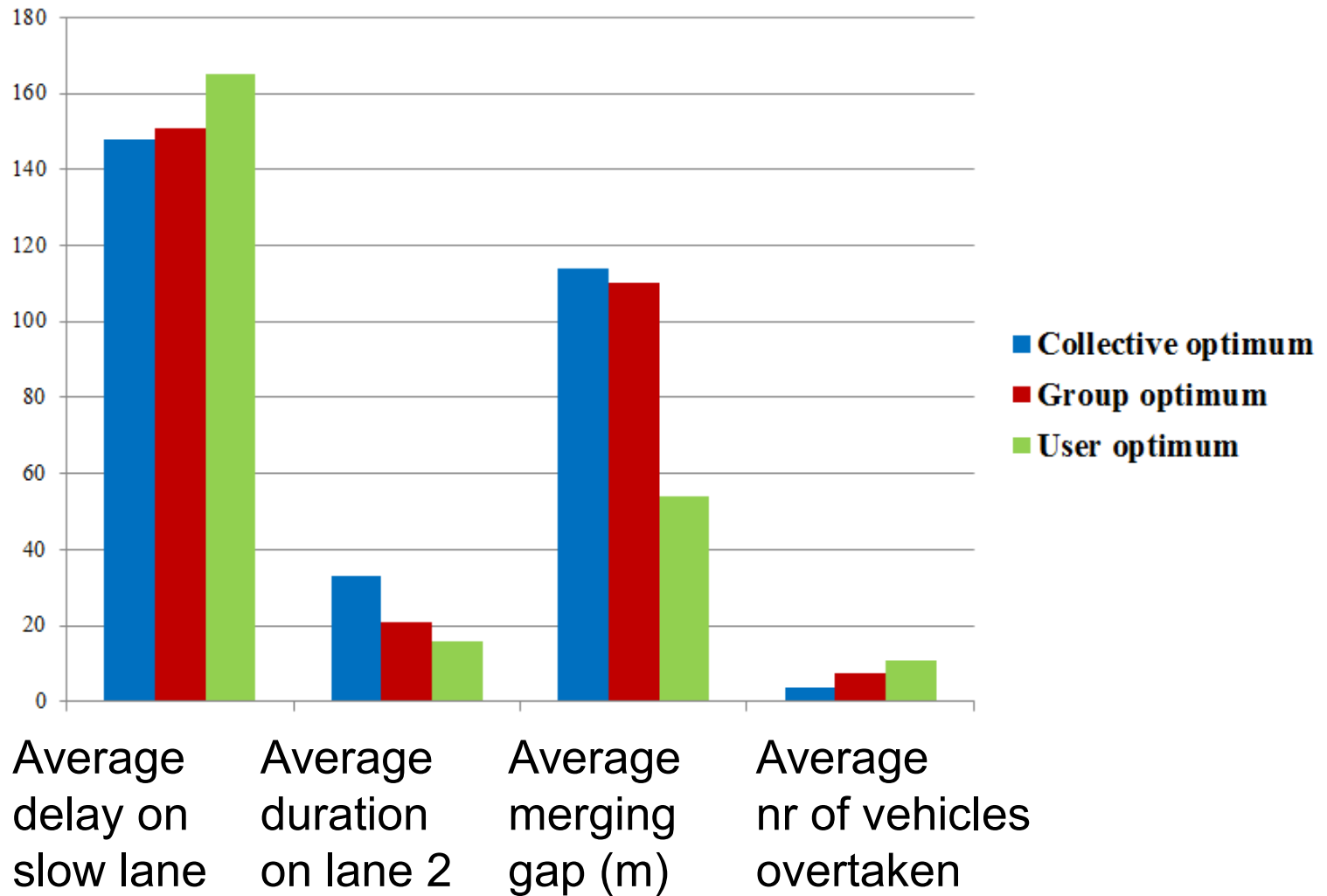
- Some wait for gaps, but less...



Properties: travel times



Properties: traffic flow



Conclusions

- Delay depends on
 - lane change instance
 - Optimization objective
- Group optimum leads to lower travel times for individual users
- All users are better off if one waits for a gap, even the driver itself, benefitting from others