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Modelling and controlling virus spread processes in shared mobility networks

We anticipate substantial changes to post-corona[1] urban mobility, when safety concerns will drive individual, as well as, public decision makers. Travellers' choices are likely to shift towards modes of low exposure to viruses. Consequently, the sustainable mobility paradigm needs to drift into 'sustainable, yet safe', unleashing a novel trade-off dilemmas spanned between: cost-comfort-safety for individuals and: sustainability-efficiency-safety for policymakers. Outcomes of those decision patterns are likely to disturb landscape of urban mobility. When sustainable mass transit modes start being avoided by risk averse travellers, it may have devastating consequences on performance of transport systems (congestion and traffic delays) and its externalities (emissions, pressure on public space, etc.), which shall be counteracted.

Notably, due to recent, disruptive changes in urban mobility, the, so-called, shared mobility (where two or more travellers share the same vehicle to reach the destination), provided via two-sided platforms (like `Uber` and `Lyft`), has proven to be an appealing alternative. Whether it will remain attractive solution for emerging mobility problems remains unknown. In particular, it is not known: a) how travellers willingness-to-share will change b) how viruses spread through the shareability graph c) how can we redesign shared rides system to control spreading and make sharing rides safe. This calls for a new set of models, theories and analyses to understand how shared rides can contribute to post-corona urban mobility. To this end, in this project we aim to:

> **WP1:forecast demand for post-corona shared mobility** Data-driven travel behaviour modelling. Series of stated preference experiments to estimate the post-corona willingness-to-share among the virus-aware travellers. Predict a presumably non-deterministic, heterogeneous travellers' reaction to applied measures and virus exposure.

> **WP2: model virus spreading on shared mobility networks** Epidemic simulations with stochastic, time evolving contact networks. Reproduce and understand contact networks emerging from shared mobility to better model and predict spreading processes. Analyse structure of underlying network connectivity and identify hubs, communities, size and depth of diffusion trees and giant components.

> **WP3: propose efficient strategies to trace and control it**
> Control, trace and halt spreading with a proactive strategic, tactical and operational system management to make sharing safe again. Demand management to keep system attractive, yet controlling the contact to prevent a future outbreaks.

One of lately emerging urban transportation modes is **shared-mobility**, available at platforms (like `Uber` and `Lyft`).
Travellers, requesting rides from mobility platforms, are offered a shared ride, where a vehicle offers to pick them up at their origin and drop them off at their destination at specific times. Both pick-up and travel times may deviate from the desired or minimal ones, since the vehicle needs to meet the requirements of all pooled travel requests.
Sharing travellers form a complex networks, which, similarly to social networks, are neither optimally designed, nor centrally planned, yet result from individual decisions of independent agents which makes it scientifically challenging and intriguing.
The potential of shared rides to serve as alternative in post-corona mobility is hitherto unknown.

[1] COVID-19, SARS CoV 2 pandemic of 2020