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# Poster

## Complex Intersections with a Dedicated Road Lane per Crossing Direction

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## Abstract

Complex intersections are often busier with a separate road lane per crossing direction, i.e., left, straight, and right. These intersections eliminate the diverging and merging conflicts; thus, vehicles only fall under crossing conflicts within intersections. However, the traditional way of serving vehicles from one road at a time increases traffic congestion and hinders performance. To address this issue, we extended the synchronous framework for complex intersections with a separate road lane per crossing direction, which was initially presented for single-lane and two-lane intersections in which roads are shared among vehicles with different crossing directions. We compare the performance of our synchronous framework against the traditional Round-Robin (RR) intersection management approach.

# Complex Intersections with a Dedicated Road Lane per Crossing Direction

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**Abstract**

Complex intersections are often busier with multiple road lanes. These road lanes can be either dedicated to each crossing direction, i.e., one road lane per left, straight, and right-crossing, or shared between multiple crossing directions. Numerous intersection management (IM) strategies have been presented to manage continuously growing traffic over the years (Namazi et al., 2019). Figure 1a presents a real-world complex intersection with multiple road lanes as a motivational intersection. Relying on this, we designed intersections with a separate road lane per crossing direction. In these kinds of intersections, right-crossing vehicles have the right-of-way. Therefore, only the straight- and left-crossing vehicle lanes fall under traffic signal control. One way of serving such intersections is permitting vehicles from one roadway at a time, then shifting to the next roadway. The conventional Round-Robin (RR) IM approach is an example of this kind, shown in Figure 1b.

In contrast, the synchronous intersection management protocol (SIMP) synchronizes vehicle intersection access from multiple road lanes but one vehicle from each non-conflicting road lane (Reddy et al. 2019, 2020). This abstract presents an extension to the SIMP for serving four-way three-lane intersections. SIMP can choose the non-conflicting road lanes associated with the straight-crossing North and South lanes, as shown in Figure 1c. The selection of non-conflicting road lanes is based on the presence of the vehicle at the intersection entrance identified using the induction loop detectors placed in various places around intersections.

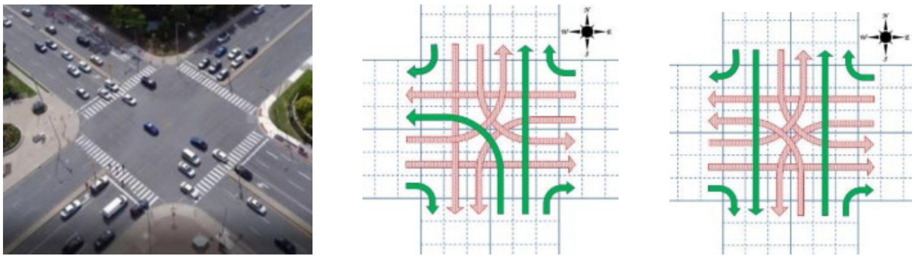

**Figure 1: a).** Real-world road intersection, **b).** vehicles serving from one road at a time, and **c).** vehicles serving from multiple road lanes.

We use the SUMO simulator to build the road network mentioned earlier and compare RR and SIMP IM approaches (Lopez et al., 2018). The traffic is generated for various traffic arrival rates using a Poisson distribution and randomly distributed equally to the three crossing

directions at 30km/h speed without U-turns to the source. For the other parameters, associated values, and fuel consumption model, see Reddy et al. (2019, 2020).

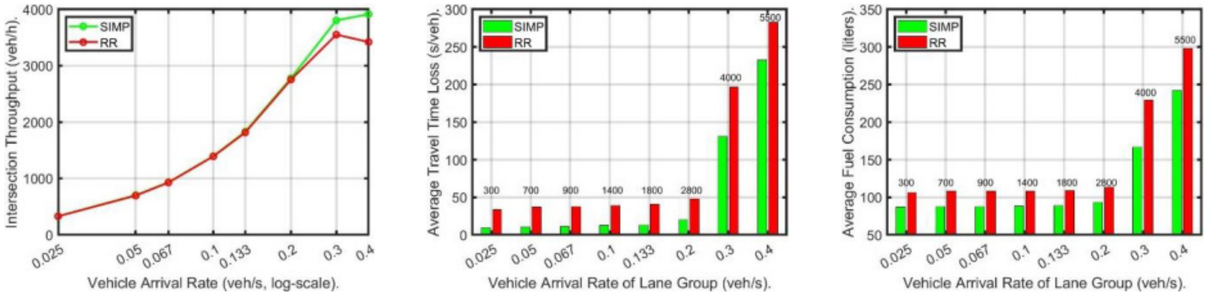


**Figure 2: a)**. Intersection throughput, **b).** average travel time loss, and **c).** average fuel consumption.

Figure 2a, 2b, and 2c show the comparing IM approaches performance respecting the intersection throughput (veh/h) and average results of travel time loss (s/veh) and fuel consumption (liters) for various arrival rates and vehicle count. The throughput results indicate that the SIMP serves the highest number of vehicles due to the synchronous way of serving vehicles and saturates at 0.4veh/s against the conventional RR, which saturate at 0.3veh/s. The travel time loss combines the waiting time at intersections and the time lost due to speed deviations like acceleration/deceleration for safe driving between consecutive vehicles. The travel time loss results show that the SIMP is the best approach with the lowest travel time loss values against RR. The fuel consumption results also show that similar trends correlate with the travel time results.


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