

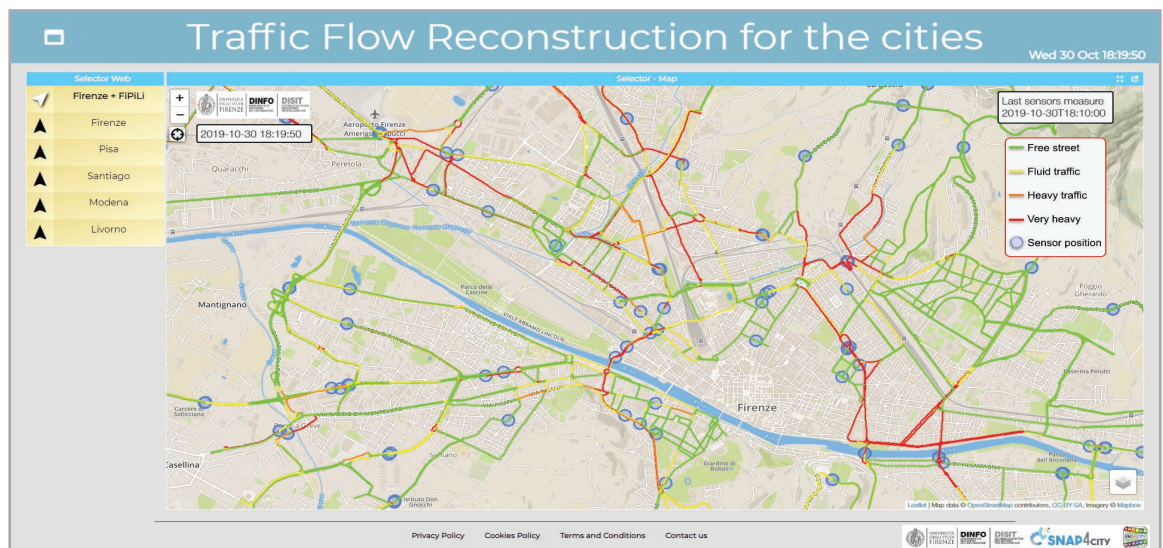


Traffic Flow Reconstruction

The City Operators need to get a real time view of the city traffic in at least all major roads of the city, since the knowledge of traffic conditions (typically provided in terms of traffic density) in real time may be used in relevant and well as critical city service applications, and also for city users, such as:

- Dynamic routing to avoid crowded conditions, police, rescue teams, ambulance, fire brigade, ...
- Inform citizens and city operators for taking alternative paths;
- Regulating the traffic lights, changing the Intelligent Transport System schedule and configuration;
- Tuning the public transportation service, for example changing paths and time schedule;
- Receiving and classifying traffic events to see them in real time and clustering them;
- assessment of the impact of the performed traffic regulation, configuration changes;
- Assessing anomalies with respect to the regular traffic conditions;
- Estimating the production of NO, NO2 from the vehicles in the city.

Dense Traffic Flow computed on statistical basis can be provided by companies that collect data from navigators, bike sharing, car sharing, mobile App with GPS data collection, and traffic sensors. A part of the latter, all the other solutions are based on the estimation of the flow on the basis of the velocity and position of the users in their vehicles. Their position and velocity may be affected by relevant errors if the number of people for road segment is not high. Also very diffuse operators cannot guarantee high precision that would means high number of users per road segment.



<https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MTc5NQ==>

Snap4City provide a precise traffic flow reconstruction computed from traffic flow sensors (spires and virtual spires). They are typically located on the crossroads and/or along the major roads segments. The approach resulted to outperform the above mentioned statistical methods and those based on queue theory. The Snap4City solution is capable of counting the different kind of vehicles: bus, truck, cars, motorbike, etc. Once obtained the measures, the traffic flow reconstruction with the aim of computing the flow in all city segments can be performed.

**Traffic Flow
Reconstruction**

**Firenze
Santiago di
Compostela
Modena
Pisa
Livorno
Fi-Pi-Li**

The above Snap4City Dashboard and solution provides: (i) location of traffic sensors, and the (ii) traffic flow reconstructed for a number of cities in Tuscany (Firenze, Pisa, Livorno), in Modena (Reggio Emilia region of Italy) and in Santiago di Compostela (Spain), and in the high speed highways Fi-Pi-Li. The computation and dashboard show the city traffic in all primary and secondary street segments of the city representing the flow with a color coding, for each segment of 20mt. On the other hand, the traffic density is computed as a floating point data for each segment that can be profitably used for the above mentioned algorithms.

Snap4City Traffic Flow reconstruction tools are based on machine learning and partial differential equations solution that regards the problem as traffic flow network. The Traffic Flow reconstruction algorithm needs of a learning phase, of a calibration phase. Then it can be executed in real time. For example, if the sensors are providing a new data every 5 minutes the traffic flow in all other segments is computed in 1 minute.

The solution has been demonstrated to overcome in precision the solutions based on queue models as well as those based on crowd sourcing data from mobile App and navigators. Please note that, in the context of mobility and transport DISIT Lab have developed a set of solution such as:

- Computation of General city traffic flows entering/exiting of the city
- Computation of average delay on Public Bus transportation with respect to the official schedule
- Smart Parking solution, with precision higher of 97%
- Clustering of road accidents in the city/region
- Analysis and simulation of mobility demand vs transportation offer
- Wi-Fi people flow predictions (high precision)
- Routing, multimodal and conditional routing,, what-if analysis

The above solutions can be tested on Snap4City Dashboards which are publicly accessible from <https://www.snap4city.org>, and from the mobile Apps: *Toscana What Where ... Km4City*, *Toscana in a Snap*. In the Dashboards, you can zoom and see the traffic flow details.



Other examples and connected scenarios:

- Traffic Flow reconstructions: <https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MTc5NQ==>
- What If analysis dashboard online help: <https://www.snap4city.org/521>
- Data Analytics: the cases of Antwerp and Helsinki, and general views <https://www.snap4city.org/524>
- Balancing of traffic in Florence, ingoing and outgoing flows: <https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MTc2MQ==>
- Dashboard on Mobility on Florence: <https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=OTA5>
- Dashboard on mobility Pisa: <https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MjUy>
- Dashboard Life in Toscana with Origin Destination matrices: <https://www.snap4city.org/dashboardSmartCity/view/index.php?iddashboard=MTc3NA==>
- P. Bellini, S. Bilotta, P. Nesi, M. Paolucci, M. Soderi, "Traffic Flow Reconstruction from Scattered Data", IEEE SMARTCOMP, IEEE international conference on smart computing, 18-20 June, Taormina, Sicily, Italy. 2018 <https://ieeexplore.ieee.org/abstract/document/8421365/>
- P. Bellini, S. Bilotta, P. Nesi, M. Paolucci, M. Soderi, "Real-Time Traffic Estimation of Unmonitored Roads", IEEE-DataCom'2018, Athen, 2018 <https://ieeexplore.ieee.org/abstract/document/8512000>
- C. Badii, P. Nesi, I. Paoli, "Predicting available parking slots on critical and regular services exploiting a range of open data", IEEE Access, 2018, <https://ieeexplore.ieee.org/abstract/document/8430514/>

**Offer vs
Demand
Analysis**

Extended version accessible from: <https://www.snap4city.org/543>
Contact: <https://www.snap4city.org>