

CHAPTER 88

Sochi

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Major sport events usually attract huge crowds of spectators, as well as media reporters, necessitating numerous official helpers in various locations to guide and support attendants; naturally, all athletes must also be at the right place at the right time. For large, international contests like Olympic games or soccer championships, accommodations are rarely close to the event facilities, making it necessary to transport spectators, media, helpers and athletes efficiently over long distances. As such events typically run for multiple days, or even weeks, with ever-changing combinations of locations and times where actual competitions take place, substantial planning is required to ensure that all attendants and participants reach their event locations in time.

Masterconcept Consulting GmbH (Gesellschaft mit beschränkter Haftung), an Austrian consulting company, has positioned itself to provide high-level concepts for large sport events. To better serve its clients, it developed ITSOS (Intermodal Transport Simulation & Operation System), a GIS-based system to support its transport planners in the creation of mobility concepts for major events, as well as regional planning. When simulating the planned events, ITSOS depends heavily on MATSim to verify that special infrastructure at major events can handle transport within required time frames, to and from specific event locations.

Senozon AG was responsible for integrating MATSim with ITSOS and adding ITSOS-specific functionality to MATSim. Together, they created a test scenario depicting the 2014 Olympic winter games in Sochi.

88.1 System Overview

ITSOS used ArchGIS for storing and editing infrastructure data, like road and train networks and event facilities. A custom plug-in also provided a graphical user interface inside ArchGIS to specify transit routes and schedules, vehicle types and their assignments to lines and departures, as well as methods describing expected travel demand. Transport planners could create and manage scenarios and scenario variants directly from the custom user interface available inside ArchGIS.

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After successful modeling of a scenario in ArchGIS, a planner could export the network and transit schedule in MATSim’s XML format directly from ITSOS to a local directory. The travel demand information, consisting of activity-chains, with zone- or facility-references and number of persons having such a chain, was exported as tabular information. A special program created a MATSim population file from this tabular data, along with a default config file.

The user could then start the MATSim simulation, using a simple bat-file on Windows. After the simulation ended, events were preprocessed and imported into a database, from which they could be queried and used within ArchGIS for analysis and visualization purposes.

88.2 Extensions to MATSim

The various groups at major sport events require different handling; in addition to athletes, there are media reporters, officials, helpers, caterers, and, of course, many spectators. Persons from different groups attending the same event will have different requirements about when to be at the event location, what entrance to use for the event location and the kind of transport necessary to reach the location. For this reason, supporting sub-populations for replanning and scoring was an important issue. Different transit offerings were also defined for different agent groups, because spectator mass transport must usually be separate from athlete and official transport.

To facilitate transport planners’ work, transit lines in ITSOS were defined with adaptive schedules; given a base headway, additional departures were scheduled between iterations, if high occupancy was expected to occur on a line during specific hours. This adjustment was based on a rule set that ensured a minimum duration for the shorter headway, as well as a minimum duration for the base headway between the shorter headways. Figure 88.1 shows the graphical schedule of an adaptive transit line after 80 iterations.

In addition to private car traffic and schedule-based public transport, athletes, media and officials also use special transportation offerings: shuttle buses, or even limousine services operating on demand, between only two or more fixed locations. Termed “transit on demand” in ITSOS, transit lines with stops along a route were defined, but without scheduled departures. Instead, a within-day-like operator was implemented, scheduling vehicles whenever someone from an agent group wished to depart. The rule-based operator had additional constraints, like minimum occupancy of on-demand vehicles before departure (to prevent every on-demand vehicle transporting only

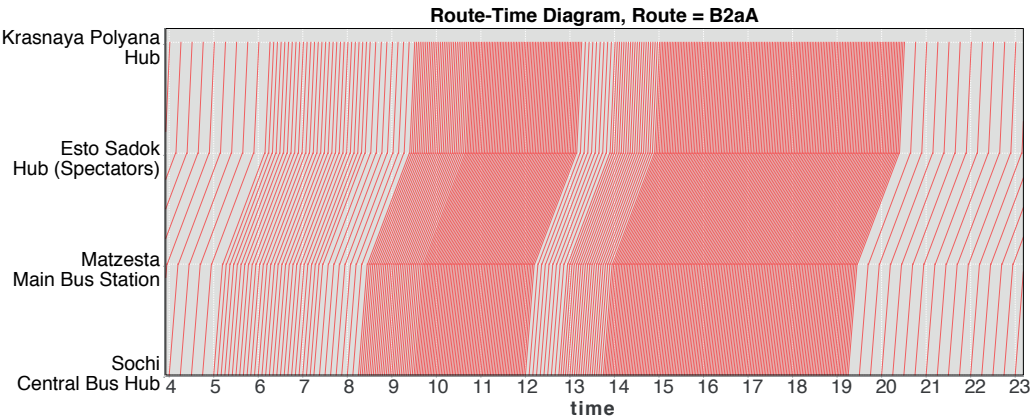


Figure 88.1: Bus schedule with automatically adapted headways based on simulated demand for bus line from Sochi (Central Bus Hub) to Krasnaya Polyana (Hub).



Figure 88.2: Simulated pedestrians (red circles) at Krasnaya Polyana hub. Transit vehicles (incl. cable cars) shown as green boxes, transit stops as blue circles.

a single agent), as well as a maximum waiting time before departure for such vehicles (to prevent agents in remote locations having to wait forever).

At sport events, large number of spectators have to share both common entrances to event facilities and common access paths to those facilities. This made it necessary to simulate more detailed pedestrian flows (in certain places) than just the default teleportation approach typically used by MATSim. For Olympic games, this was even more crucial because, in several locations, security checks created additional bottlenecks. This requirement was solved by implementing a special router for the walk mode, along with a custom departure handler. The router tried to find a path on the network for walk legs, assessing distance from the closest walk link to/from a facility to decide if the link functions as an access to the facility or not. If no nearby link was found, or no route found between two access links, an empty route was stored in the leg. The departure handler checked whether the route was empty or not, either teleporting the agent or putting it on a walk link in the network. Walk links are regular queue-based network links with capacity and free-speed set, according to the simplified physics of directed pedestrian flows. This approach readily allowed modeling of security screening gates' bottleneck effects and considered essential walk path locations where necessary. These were modeled, omitting them on non-critical routes. Figure 88.2 shows an example of simulated pedestrian movements at Krasnaya Polyana, the mountain area near Sochi where numerous events took place.

88.3 Simulation of Sochi

To test ITSOS applicability for major events transportation planning, a model of the 2014 Olympic winter games in Sochi (Russia) was built. Data was either collected either by Masterconcept employees or cooperating companies, or received from Russian governmental institutions.

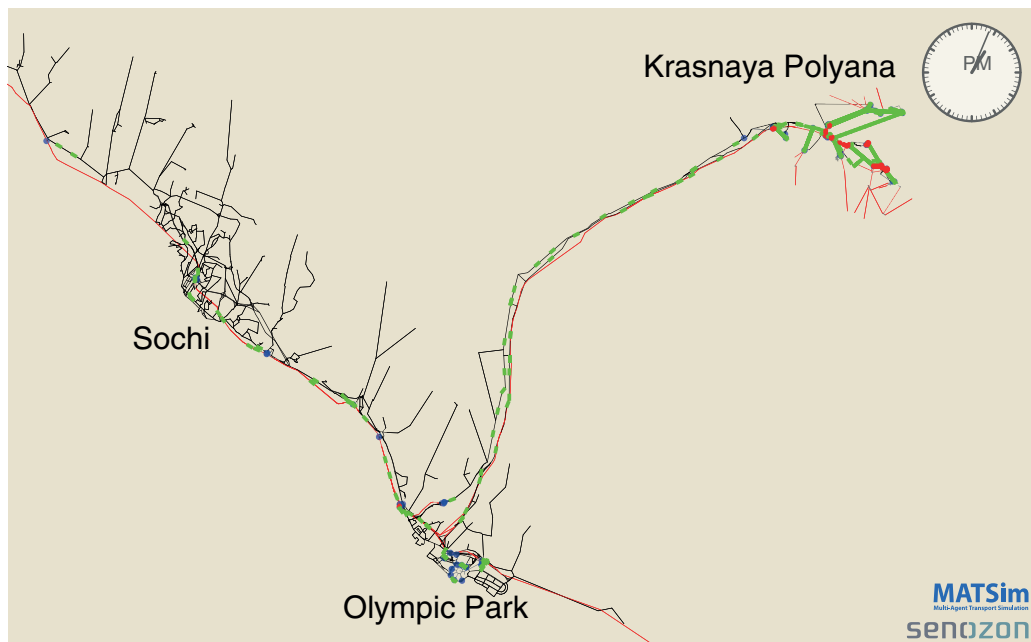


Figure 88.3: Overview of the Sochi model.

Road and train networks were modeled in ArchGIS, using the ITSOS extensions. The transit schedule included 55 transit lines, a mix of bus lines, train lines, and cable cars, going up into the mountain areas. 24 of those lines were defined to be adaptive, 19 lines operated on-demand as shuttle services.

Travel demand was defined for each day of the games, based on the actual schedules, making assumptions about how many spectators would visit each different competition during the day. While size of event facilities can be used as a upper limit for number of spectators, substantial experience and knowledge from Masterconcept was used to define actual numbers of people expected at each event.

Events often start and end at different times of day, because many event locations share, at least partially, a common route to reach them; it was important to simulate whether the transport services offered could cope with the combined travel demand generated by multiple, separate events.

A typical simulation run of Sochi included about 150 000 agents. To speed up simulations, parallel events handling and parallel qsim was used. The simulation generated around 15 million events per iteration. Figure 88.3 shows a screenshot of the Sochi scenario, visualized in Via.

88.4 Outlook

In addition to the test case of the 2014 Olympic winter games in Sochi, ITSOS/MATSim was also used to simulate traffic in St. Johann (Pongau, Austria), with particular emphasis on pupils, who often must take a combination of buses and trains to get to school.

A new company, Masterconcept Mobility GmbH, was split off from Masterconcept Consulting GmbH in 2014; this new firm offers major event transportation planning services, as well as regional planning services based on the combination of ITSOS and MATSim.