



POLITECNICO
MILANO 1863

Analyzing cyclists' perceptions of safety and comfort: use of bike simulator and other tools

08.10.2025 | Beatrice Bianchini, Marco Ponti, Luca Studer

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About us

01

Mobility and Transport Laboratory

Managed by a research group focused on:

- planning of mobility systems and services
- transport system safety
- sustainable mobility
- intelligent transport systems (telematics applied to transport)



**TRANSPORT
PLANNING**



**TRANSPORT
NETWORKS**



**TRANSPORT
SAFETY**



**SUSTAINABLE
MOBILITY**



**INTELLIGENT
TRANSPORT SYSTEMS**



Goals

02

Goals

Overall objective

To promote the use of sustainable means of transport that can:

- reduce pollution and traffic congestion
- increase personal well-being and the livability of urban areas

Critical issues (particularly in Italy)

- lack of cycle paths and dedicated infrastructures (although this is improving)
- people's reluctance to use bicycles due to poor comfort and safety conditions on the roads

Goals

Research directions

- investigate the level of **comfort and safety perceived by cyclists** in different road and contextual conditions (road sections and intersections)
- quantify the **impact of different infrastructure aspects** (road width, pavement types, physical barriers, level of motorized traffic, etc.) on this perception
- determine the **level of attention aroused** by specific road elements and the level of **psychological and physical stress** experienced by cyclists under specific conditions



Applications

03

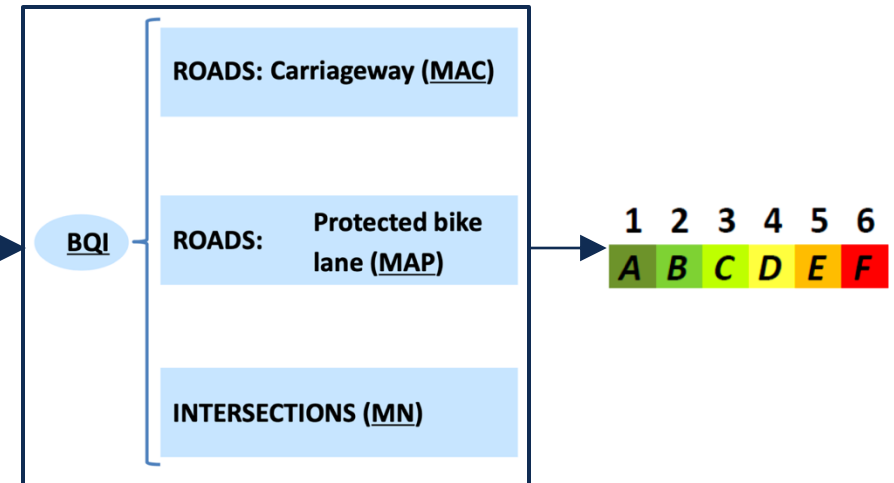
Applications

Definition of a Bike Quality Index:

- It represents a sort of Bicycle Level Of Service:
 - for each link (road sections and protected bike lanes)
 - for each node (intersections)
- The index is mainly determined by the cyclist's perception of safety and comfort
- It's built starting from the most significant characteristics of a road section or an intersection valued by the cyclists



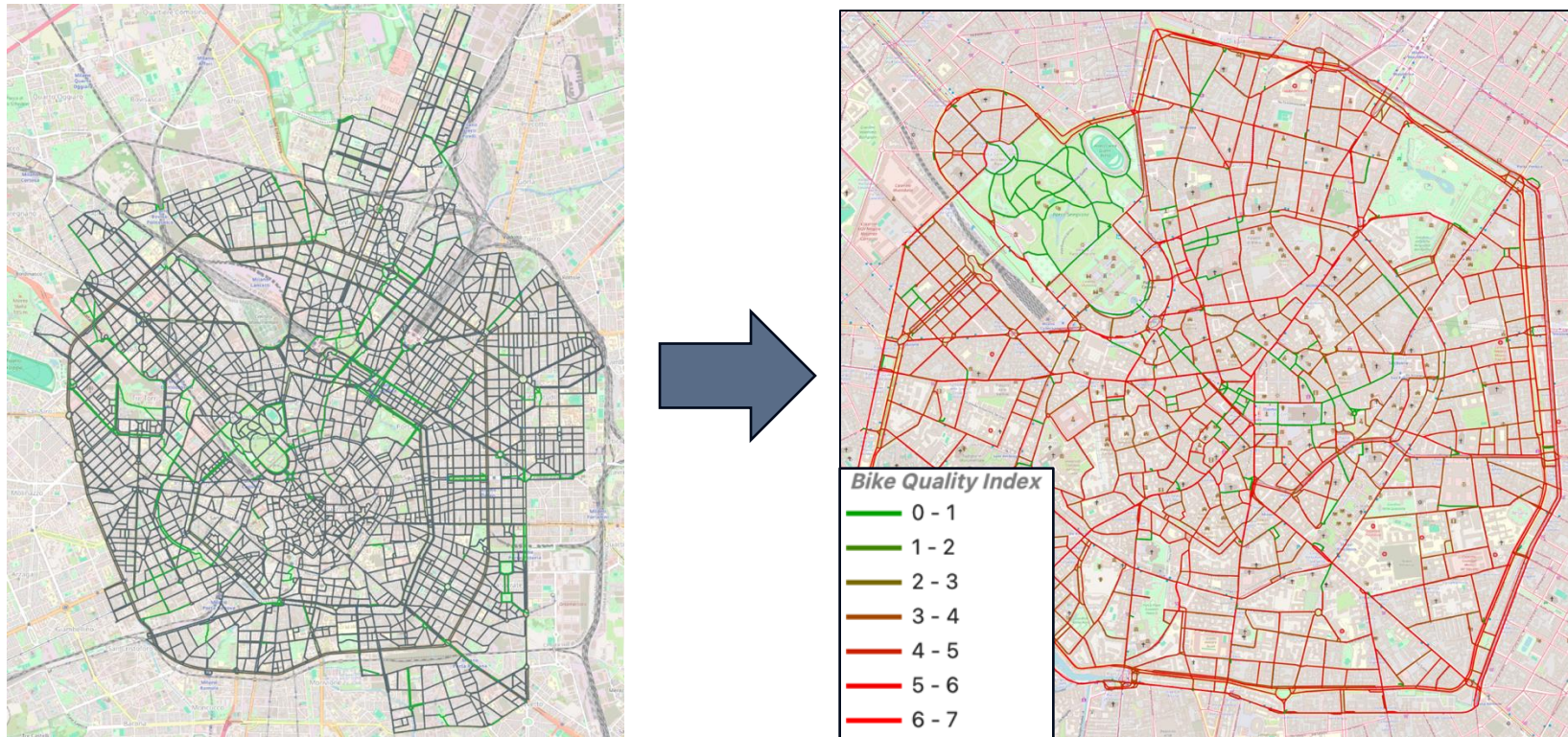
L_e = **width** of the outside lane of traffic [m]
 F_1 = **flow** of motorized traffic in the outside lane (adjacent to the cyclist) [veic/h]
 F_2 = flow of motorized traffic in the opposite direction [veic/h]
 V = average **speed** of motorized traffic [km/h]
 f_{parc} = **parking** on the road: % occupancy $[0 \div 1]$
 F_{cicl} = presence of bike lane bordered only by horizontal strip $[0|1]$
 F_{pav} = **pavement**: presence of pav. class 3 (cobble) $[0|1]$



Applications

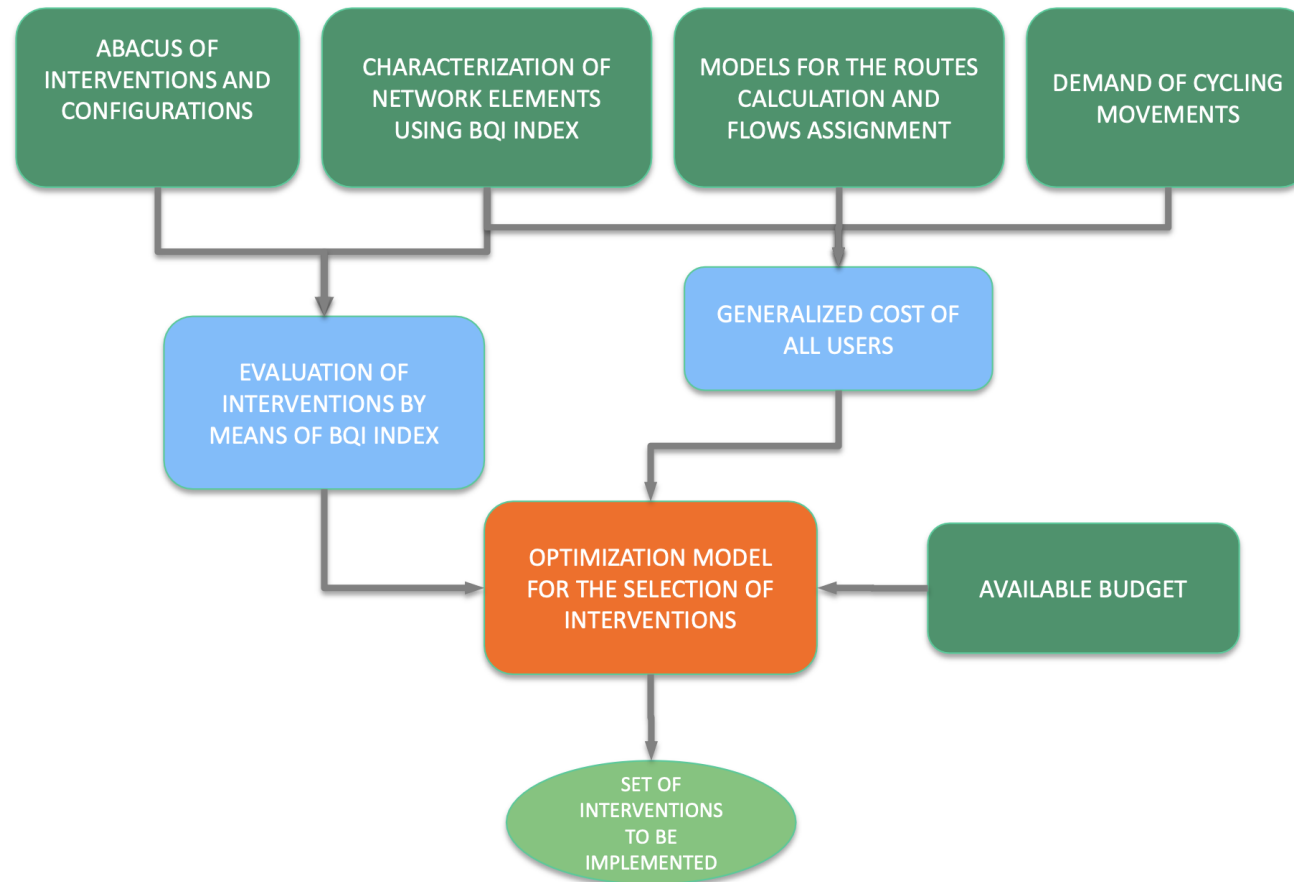
Definition of a Bike Quality Index:

- Classification of a road network (e.g. city center) according to the Bike Quality Index



Applications

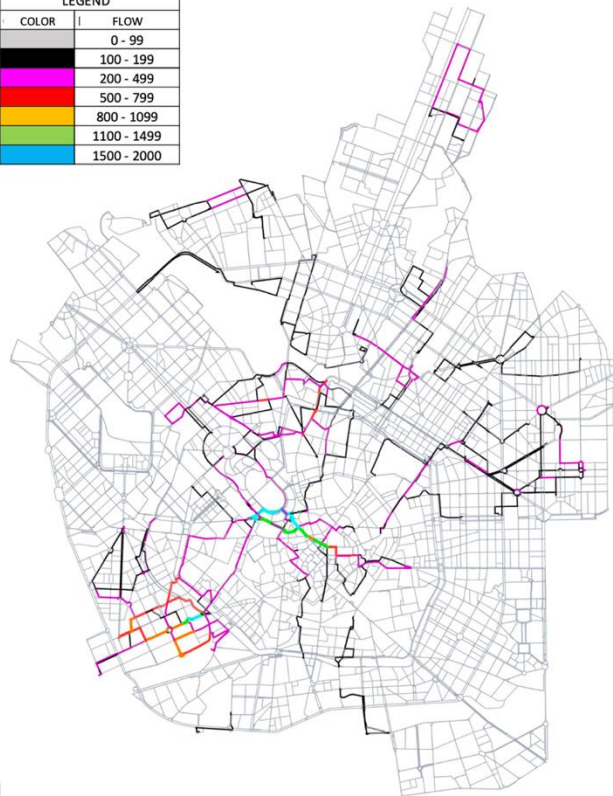
Development of a decision-support tool to identify priority interventions on the road network



Applications

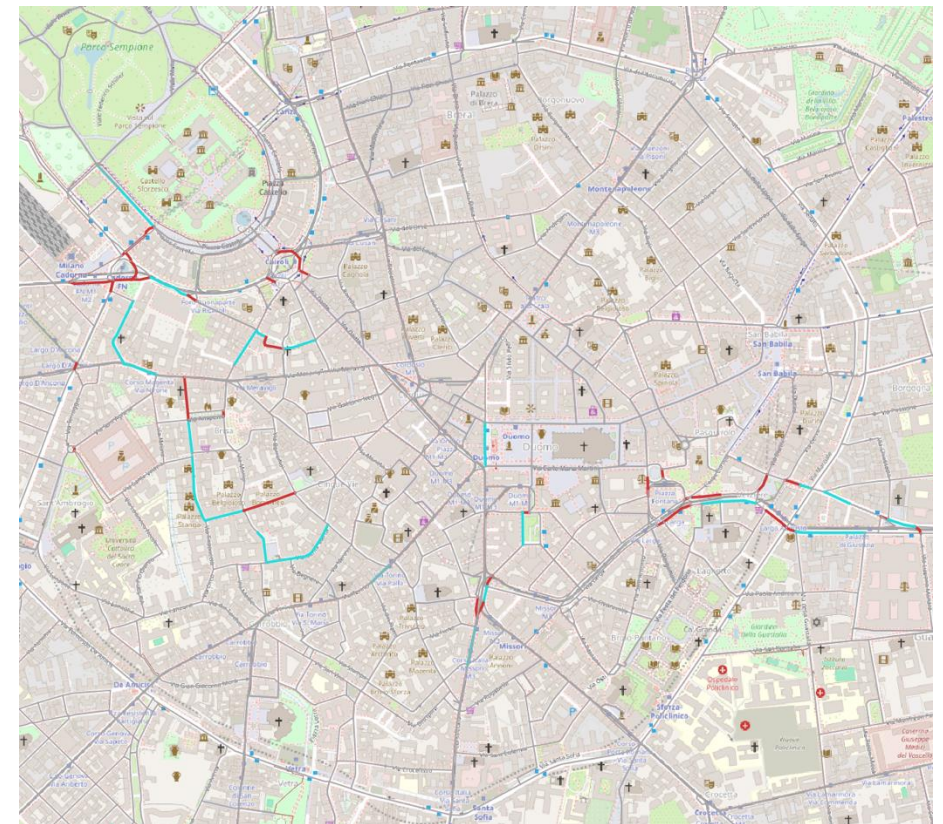
Development of a decision-support tool to identify priority interventions on the road network

LEGEND	
COLOR	FLOW
Black	0 - 99
Magenta	100 - 199
Red	200 - 499
Orange	500 - 799
Yellow	800 - 1099
Green	1100 - 1499
Blue	1500 - 2000



Distribution and quantification of cyclist flows on the network

Example of proposed interventions on the network links:
red = insertion of an unprotected bike lane
blue = removal of parking spaces with simultaneous insertion of a mixed lane





Instrumentation

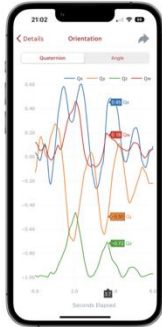
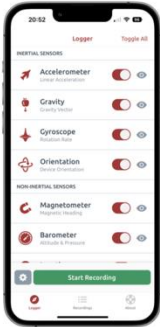
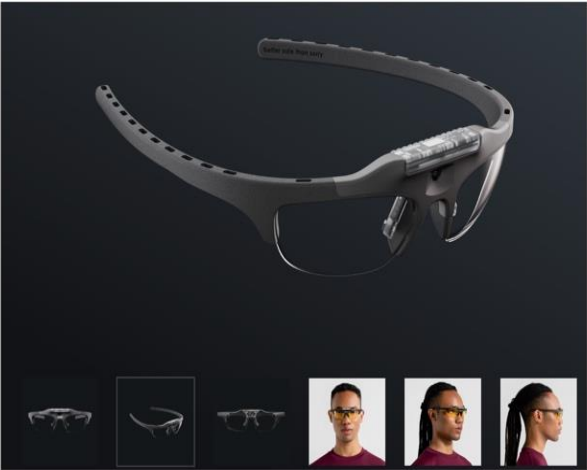
04

Instrumentation

The equipment acquired by the laboratory is intended for conducting experiments and tests aimed at:

- testing cyclists' perceptions on the road and in a virtual environment
- better calibrating bike quality indices
- conducting targeted experiments on cyclists' behavior and psychophysical stress, to identify critical aspects for safety

Instrumentation





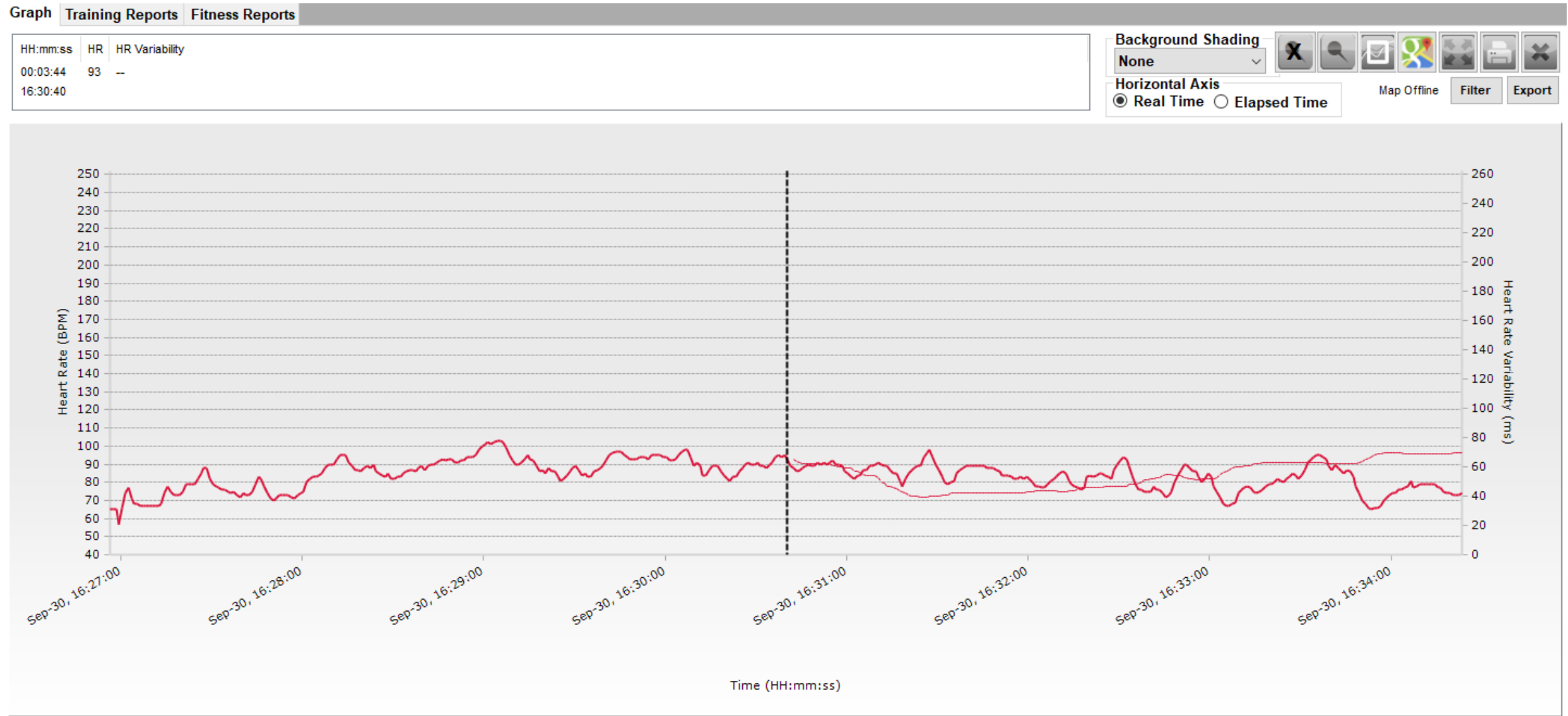
Output examples

05

Sensor logger APP: GPS track, vertical accelerations (road surface irregularities)

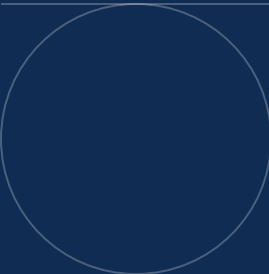


Zephir Bioharness: hearth rate, hearth rate variability, etc.



Eye-tracker





Thank you for your attention.



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