Quote for
Politecnico di Bari
Department of Civil, Environmental, Land,
Building Engineering and Chemistry (DICATECh)
Prof. Ordinario Michele Ottomanelli

Date: 17.02.2025

VRU-Research Simulators

Bicycle Simulator
Pedestrian Simulator

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SUBJECT OF THE OFFER

The subject of the offer is the construction and delivery of a bicycle and a pedestrian simulator to be used at the Politecnico di Bari for research purposes.

The offer is divided into the following work packages:

- WP1: Bicycle Simulator
- WP2: Pedestrian Simulator

The simulators offered are already in use both at WIVW and with customers. They have already been used for research and development purposes (e.g. Berghoefer & Vollrath, 2023; Brand & Schmitz, 2025; Huemer et al., 2022, Kaß et al.,2020, Stemmler et al., 2024, Suing, 2024)[1].

1 WP1: BICYCLE SIMULATOR

The bicycle simulator is divided into the following work packages:

- WP1.1: Hardware setup (vision system, mockup and computer network)
- WP1.2: Simulation software-packages (SILAB and SILAB BICYCLE)
- WP1.3: On-site delivery, installation and commissioning of the simulator
- WP1.4: Instruction and software training
- WP1.5: Support, Care and Maintenance

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Kaß, C., Schoch, S., Naujoks, F., Hergeth, S., Keinath, A., & Neukum, A. (2020). A methodological approach to determine the benefits of external HMI during interactions between cyclists and automated vehicles: A bicycle simulator study. In H. Krömker (Ed.), HCI in Mobility, Transport, and Automotive Systems. Driving Behavior, Urban and Smart Mobility. HCII 2020 (pp. 211-227).

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1.1 WP1.1: Hardware Setup

1.1.1 WP1.1.1: Vision system (180° view)

In order to enable realistic visualization, an LED solution is offered as a vision system. In the basic configuration, this includes a vision system with approx. 180° visibility, 6 single LED panels (resolution: Full-HD or higher).

Optionally, a view extension to a total of 12 LED individual panels is offered, resulting in a completely closed viewing system (360° view). A corresponding setup is shown as an example in Figure 1-1. The components required for this optional extension are described in section 1.1.4 .

The scope of the basic configuration of the vision system includes:

- 6 LED panels (panel resolution 4k, size: approx. 50"). The graphic simulation controls the panels with a resolution of 2560 x 1440.
- 3 monitor stands
- 3 operator monitors

Figure 1-1: 360° viewing system of the WIVW, left: unfolded, right: viewing system in test mode and operator workplace with monitors.

1.1.2 WP1.1.2: Mockup

The bicycle mockup consists of a sensor/actuator setup and a (commercially available) bicycle adapted for the simulation.

1.1.2.1 Bicycle mockup

The following configuration is proposed as the basis for the mockup (the variant will be agreed with the customer after the order has been placed):

- Bicycle frame shape: (commercial) trapezoidal frame, medium frame size. If necessary, a low-entry frame is also possible at the customer's request. Figure 1-2 illustrates possible assembly variants based on different bicycle frame shapes. Figure 1-3 shows a current setup for a customer project (trekking trapeze).

Figure 1-2: Assembly variants: Trekking trapeze (left) or city bike low entry (right).

- Gears: derailleur gears, mechanical gear indicators, if necessary, number of gears and transmission ranges can be adjusted according to the customer's wishes.
- Brakes: (commercially available) hydraulic bicycle brake system, front and rear brake levers.
- Seatpost/rear: Dropper seatpost, can be operated by the test person using a handlebar lever.
- Handlebar/Front: Tool-free height-adjustable handlebar.

Figure 1-3: Example trekking trapeze setup.

The bicycle can only be used as a simulator mockup and cannot or must not be driven on public roads. The resistance unit of the mockup is silent by design and therefore does not create any disturbing noises.

1.1.2.2 Sensor/actuator design

1.1.2.2.1 Riding resistance and steering

Figure 1-4: Cycletrainer (left) and steering plate (right).

With regard to the sensor and actuator design, it is planned to use a direct-drive electromagnetic cycletrainer as an actuator to adjust and measure the rider's load (Figure 1-4, left). The cycletrainer is controlled by means of the SILAB driving simulation software and the vehicle dynamics described in section 1.2. The front wheel rests on a steering plate, through which the steering angle is recorded by means of a built-in sensor (Figure 1-4, right). Cycletrainer and steering plate are mounted on a movable rocker plate. The rocker plate is installed as a passive motion tilting platform for lateral movement. A rear wheel is not included.

1.1.2.2.2 Braking system

The braking system is implemented exclusively as a sensor system (sensors on the calipers (Figure 1-5)). It is planned to use commercially available hydraulic bicycle brakes. The aim is to ensure familiar lever operation as well as realistic hand forces. The driver's lever movement is measured by (pressure) sensors, which transmit the measured values to the vehicle dynamics. The corresponding deceleration is then calculated by the vehicle dynamics and transmitted to the simulated bicycle. Since real brakes are used the lever travel and pressure point can also be adjusted mechanically in order to guarantee a realistic haptic feedback.

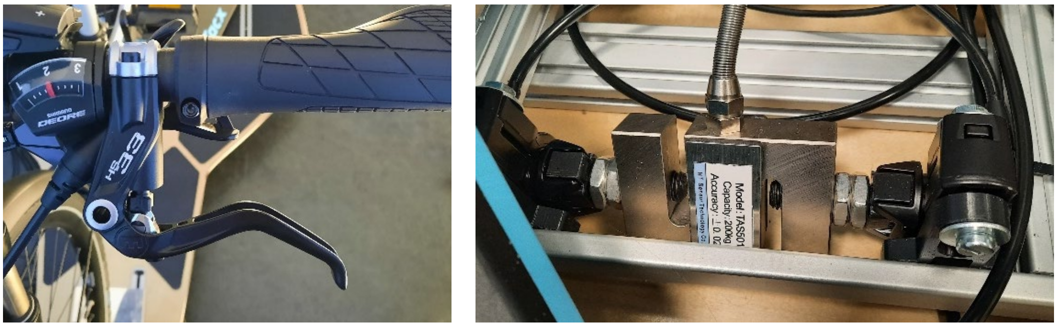

Figure 1-5: Brake lever (left), brake caliper and brake sensors (right).

1.1.2.2.3 Display and handlebar control unit

It is planned to install a small touchscreen monitor as a display. The size is based on the size of current smartphone displays. The input device is to be a standard handlebar control unit with three to five buttons, which can be freely assigned via SILAB (Figure 1-6).

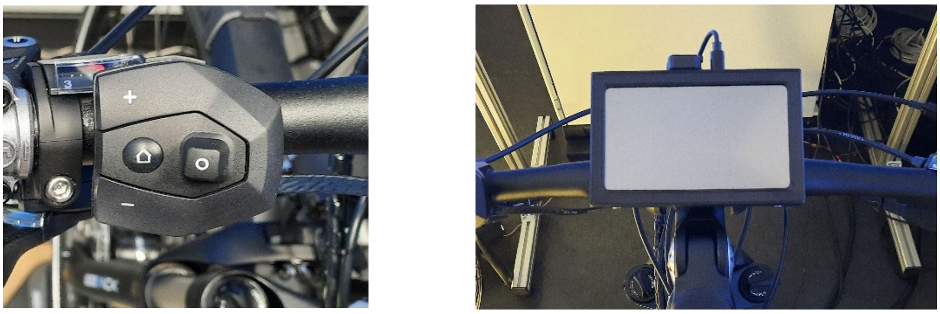

Figure 1-6: Control unit (here: BOSCH Intuiva; left) and display (right).

The display can be almost freely configured by the client e.g. to display different simulation parameters (like speed, distance travelled etc.) or to displays secondary tasks. The handlebar control unit can also be almost freely configured (e.g. to control a secondary task).

1.1.2.2.4 Tool-free adjustment of saddle height and riding position

For quick and tool-free adjustment of the saddle height and riding position, it is planned to install a so-called dropper post and a height-adjustable stem. With a dropper post, the seat height can be infinitely adjusted by the test person himself via a handlebar lever. In the case of the height-adjustable stem, the height of the front can be adjusted by the experimenter to the test person at the beginning of a test session by means of a quick release.

Figure 1-7 shows an example of a dropper post and a height-adjustable stem.

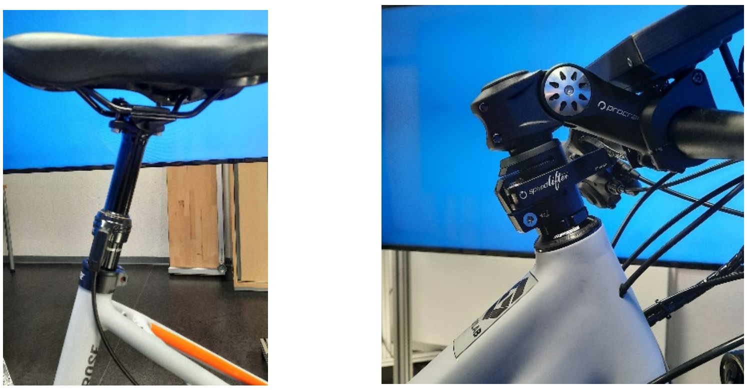

Figure 1-7: Height adjustment rear (dropper post, left) and front (tool-free height-adjustable stem, right).

1.1.2.2.5 Headwind simulation

Concerning the simulation of headwind, the use of two fans adapted to bicycle-specific aspects is planned. The fans are controlled by the SILAB simulation software and the vehicle dynamics described in section 1.2.2.2. According to the manufacturer, the maximum wind speed that can be produced is approx. 50 km/h or 6 Bft ("strong wind").

Figure 1-8: Headwind fan.

1.1.3 WP1.1.3: Computer network

The computer network of the simulator for the basic configuration of the vision system consists of 6 PCs of the following type:

In terms of performance, the specification fulfils at least the following key data:

- 19" rack with the exception of the operator PC as well as the PC for the operator views. These PCs are supplied in a tower case.
- Processor: Intel® Core™ i5-13600KF or better
- 32 GB RAM
- NVidia GeForce graphics card 4060 or higher (for the render PCs)
- 500 GB SSD
- Windows 11

This enables a smooth graphical output of the simulation that can be realized on all views with a resolution of 1920x1080 (Full-HD) at least.

Setting up the PCs with Windows 11 as well as integration of the computers into a network is part of the scope.

Due to the real-time requirement for the PCs, no virus scanner will be set up on the simulator PCs. Therefore, for security reasons, it is recommended to place the PCs on a separate network so that the risk of malware infection is minimized.

All computers are installed in a network cabinet and wired to the vision system and the bicycle mockup (maximum cable length 15 m). The client must ensure that the room is sufficiently cooled so that the PCs can be operated within their operating temperature range. This is between 10°C and 30°C.

1.1.4 WP1.1.4: Hardware: Upgrade to 360° view

As described in section 1.1.1, an optional view extension to a total of 12 LED panels is offered, resulting in a completely closed viewing system (360° view). The scope of delivery and services includes

- 3 more viewing system / render PCs
- 3 additional monitor stands
- 6 additional LED panels (size and resolution of the basic view system)
- an upgrade of the computer cabinet
- as well as the personnel costs for the extended construction and installation work.

For traffic safety research questions, we recommend the view extension to 360°.

The vision system with a view of 360° is foldable and can be opened and closed to allow the test subject a comfortable way to enter the simulation.

1.1.5 WP1.1.5: Additional hardware: Eye tracking and biosignal sensors

1.1.5.1 Eye tracking

For measuring eye movements, we recommend the Pupil Labs Core Eye Tracking System (especially when a 360° vision system is used). The system consists of an open-source software suite and a portable eye-tracking headset. A corresponding DPU for control and data recording is available in SILAB and is included in the delivery.

1.1.5.2 Biosignal sensors

For measuring various biosignals, we recommend the following 8-Channel biosignalsplux kit (SKU: 820201017) from Plux Biosignals.

The custom research kit includes an 8-channel hub as well as the following sensors:

- Electromyography (EMG) Sensor (SKU: 820201201)
- Electrodermal Activity (EDA) Sensor (SKU: 820201202)
- Electrooculography (EOG) Sensor (SKU: 820201232)
- Blood Oxygen Saturation (SpO2) Sensors (SKU: 820201239)

- Electroencephalography (EEG) Sensor (SKU: 820201204)
- Electrocardiography (ECG) Sensor (SKU: 820201219)
- Piezo-Electric Respiration (PZT) Sensor (SKU: 880971201)

Furthermore, we recommend the following accessories:

- Gelled Self-Adhesive Disposable Ag/AgCl Electrodes (SKU: 870992015)
- Nuprep Skin Preparation Gel (SKU: 870992020)
- Ten20 Conductive Paste (SKU: 870992021)

A corresponding DPU for data recording is available in SILAB and is included in the delivery.

1.2 WP1.2: Software

1.2.1 WP1.2.1: SILAB PROFESSIONAL Edition

SILAB is developed by WIVW and delivered in the current version 7.2 (see the detailed product descriptions for different editions in the attachment). We recommend SILAB PROFESSIONAL Edition. Scenario design is currently based on German guidelines for road networks. An Italian version will be developed.

1.2.2 WP 1.2.2: SILAB Software Add-on Package BICYCLE

The offer also includes the BICYCLE add-on package. The package contains modules for cycling-specific vehicle dynamics (e.g. resistance, brakes, steering, sound) as well as a short training programme to speed up familiarization with the simulator.

The cycling-specific vehicle dynamics are deliberately kept simple for the user and can be easily adapted / parameterized by the user (either globally or on a project-specific basis). The goal is to create a realistic cycling impression, a high level of immersion and meaningful, analysable simulator riding data. There is also the possibility to integrate other vehicle dynamics.

1.2.2.1 Resistance module

The resistance module controls the driver's load and simulated driving speed as a function of climb/descent, speed-dependent wind load, rolling resistance, as well as additional environmental parameters/constants. The resistance model brakes *and* accelerates the simulated bicycle depending on the corresponding environmental parameters provided by SILAB (e.g. higher riding resistance on climbs, additional acceleration due to gravitational force on descents, etc.).

The resistance module can be parameterized using the following parameters, among others:

- System weight (rider + bike + payload)
- Rolling resistance coefficient
- Drag coefficient
- Driver's frontal area
- Air density

1.2.2.2 Headwind module

The headwind module controls the travelling wind speed. The module controls both of the fans described in section 1.1.2.2.5 and the modulation of the simulated wind load in the resistance module. The simulated wind noise while riding is automatically adjusted.

1.2.2.3 Brake module

The brake module simulates a realistic bicycle brake system with independently acting front and rear brakes. The wheel load shift during braking is also taken into account, i.e. the simulated rear wheel can "lock" if braking is too hard (which is accompanied by a reduction in deceleration).

On the software side, the maximum braking force and the modulation can be set separately for the front and rear brakes. The wheel load shift can be switched on active or inactive. On the hardware side, the brake lever can be used to adjust the reach and pressure point.

The brake module can be parameterized using the following parameters:

- Maximum possible braking force for front and rear brakes separately
- Wheel load shifting
    - Geometry data of the simulated bike
    - On/Off
- Friction coefficients for tires/surfaces

1.2.2.4 Steering module

The handlebar angle of the sensor is further processed in this module. Therefore the steering ratio can be freely parameterized by the software, i.e. the actual handlebar angle and the simulated handlebar angle can differ from each other if desired. In addition, it is possible to design the steering ratio depending on the speed, e.g. to allow for different steering angles at higher/lower speeds. A freely configurable and speed-dependent rolling (i.e. a "tilting" of the horizon while steering) is also implemented, which can be switched on or off.

The steering module can be parameterized using the following parameters:

- Sensitivity of the steering as a function of the riding speed
- Rolling/tilting of the horizon as a function of riding speed

1.2.2.5 Sound module

In addition, the vehicle dynamics has a bike-specific sound module that provides both ambient sounds and the bike's own sounds. Included are: background noise (city/country), wind noise, a tyre rolling noise and brake noises (grinding noises, locking rear wheel). All sounds of the sound module can be switched on or off separately and their volume can be adjusted. The 3D sound simulation of the surrounding traffic remains unaffected by the sound module described and is generated by SILAB out of the box and is part of any SILAB edition.

The sound module includes the following <u>additional</u> sounds:

- Background/ambient noise (city noise, birds chirping, etc.)
- Airstream noise (speed-dependent)
- Rolling noise (depending on speed)
- Brake noises (e.g. locking rear wheel, "brake grinding")

The sound module includes noise-cancelling headphones to shield the driver from unwanted background noise (e.g. when using different simulators in the same room) and an intercom system for communication between the study participant and the experimenter.

1.2.2.6 Data recording

The following vehicle dynamics parameters can be recorded on the SILAB side:

- Simulated travel speed, (longitudinal) acceleration
- Braking forces (separate for front and rear wheels)
- Riding resistance forces (downhill force, wind load, rolling resistance, etc.)
- Riding power (cadence, watts)

as well as lots of other parameters like traffic/traffic participants data, lane/road information, surrounding objects etc.

1.2.2.7 Simulator familiarization

The importance of getting used to a simulator is often underestimated and neglected for reasons of time or cost. An adaptation of the test person to the psychophysical conditions contributes decisively to valid results and is therefore strongly recommended.

For this purpose, practice rides are provided to help you get used to the simulation (documentation included). The objectives are to reduce or avoid simulator sickness, objectively safe simulator control, creating a subjectively safe riding experience and getting the rider used to the examination situation.

On the acclimatization course (Figure 1-9) there are several sections for performing appropriate exercises (getting on/off, starting, braking and shifting; lane keeping and cornering).

Figure 1-9: Acclimatization course.

Several sections of the route are available for practising turning manoeuvres. Several intersections are available with different right-of-way regulations and other road users. The cyclist must get into the right or left lane accordingly, or go straight ahead, stop if necessary and start again. It is based on the navigation display/announcement. Due to the circular arrangement, the routes can be driven for any length of time until the turning is sufficiently practiced.

1.2.3 WP1.2.3: Upgrade to SILAB ENTERPRISE Edition

An upgrade to SILAB Edition ENTERPRISE is optional. Details of the different simulator software editions can be found in the product description attached.

1.2.4 Possibilities of connecting third party simulators

SILAB can be configured and programmed to export the data of all vehicles in a variable radius in real time around the EGO driver. If a third-party simulation offers the possibility to integrate this data into their traffic simulation, the vehicles can be synchronised with an external simulation. In addition, external traffic data can also be imported into SILAB.

This would allow to connect third-party simulators like other car simulators to simulate other individual vehicles that can be connected to the bicycle or the pedestrian simulator. To enable this, the scenarios on both simulators must use the same database. This can be achieved by using a common OpenDRIVE definition for the track. To realize the function described above, both the SILAB simulation as well as another the third-party simulation would have to be harmonised in a separate project. This is possible under the conditions mentioned, but is not part of this offer.

1.3 WP1.3: On-site delivery and installation/commissioning

Work package 3 includes the delivery of the components and the assembly or commissioning of the bicycle simulator on site.

Two sockets with separate fuse protection (16A with 30 mA RCD) are required for the electrical connection (one for the monitor circuit and one for the computer cabinet). The metal frame of the visual system and the computer cabinet must be included in the local potential equalisation (by the client). The low-impedance continuity of the connections must be checked (by the client). An earthing terminal for connecting the simulator must be provided by the client.

The simulator requires 25 - 30 m^2 of space at least.

A forklift truck including driver must be provided by the client for acceptance of the delivery.

1.4 WP1.4: Instruction and software training

The subject of work package 1.4 is a three-day training course for the client's personnel. This training course deals with the operation of the simulators, the functionalities of the individual software components and the use of the scenario packages included in the scope of delivery. The training takes place on site.

1.5 WP1.5: Support, Care and Maintenance

For a period of one year, starting from the date of acceptance of the system by the client – the WIVW provides services during normal business hours (Monday to Friday, 9 a.m. to 4 p.m. to ensure the operability of the system. Support requests can be received by e-mail (silab@wivw.de) or by phone (+49 931 78009-400).

Also included in this work package is the maintenance of the respective SILAB Edition software (PROFESSIONAL or ENTERPRISE) for the first two years after commissioning.

Support, care and maintenance services beyond the first two years (e.g. software updates yearly) are not subject of this offer. The current annual costs for support, care and maintenance are €7000 for SILAB Edition PROFESSIONAL and €9000 for SILAB Edition ENTERPRISE. Support, care and maintenance costs are due at the beginning of the term.

3 WP2: PEDESTRIAN SIMULATOR

The pedestrian simulator is divided into the following work packages:

- WP2.1: Hardware setup (Visual system and computer network)
- WP2.2: Simulation Software-packages (SILAB and SILAB HEAD MOUNTED DISPLAY)
- WP2.3: Delivery, installation, and commissioning of the simulator on site
- WP2.4: Instruction and software training
- WP2.5: Support, Care and Maintenance

In order to connect the pedestrian simulator with the bicycle simulator, a wired network connection between the simulators is established. To optimise the efficiency with which experiments can be conducted, it is recommended to setup the simulators close to each other, e.g. to instruct test subjects together.

SILAB enables connections between two arbitrary types of simulators. In this offer only the connection between pedestrian and bicycle simulator is included.

3.1 WP2.1: Hardware-Setup

In order to maximise immersion, the simulator supplied is equipped with a VR vision system. The various components of the simulator are described below.

3.1.1 WP2.1.1. Visual system and movement space

Current wireless VR goggles (WI-FI 6E) are used as the viewing system for the test subject. These have at least the following key technical data:

- Display resolution of 2448 x 2448 pixels per eye
- Refresh rate of 90Hz

The VR goggles are connected to the corresponding computer wirelessly. The goggles enable eye tracking data to be recorded, which can be synchronised with other driving simulation data. Instead of using a tracker-based system which requires a lengthy setup as well as the need to recharge the trackers, a zero touch multi camera-based tracking system is used.

The simulator allows a maximum size of 7 x 7 metres for the walkable area. The total space requirement is 9 x 9 metres. The test subject is provided with two hand controllers to interact with the environment. The positions of the controllers are recorded by the simulation software, and button presses can be recorded by the simulation software and presented to other participants, for example.

3.1.2 WP2.1.2. Computer network

The computer network consists of at least three computer cases, which are set up near the operator desk (operator desk is not included).

All computers required for the realisation of the described functions (software package head mounted display) are included in the scope of delivery. The client must ensure that the room is sufficiently cooled so that the PCs can be operated within their operating temperature range. This is between 10°C and 30°C.

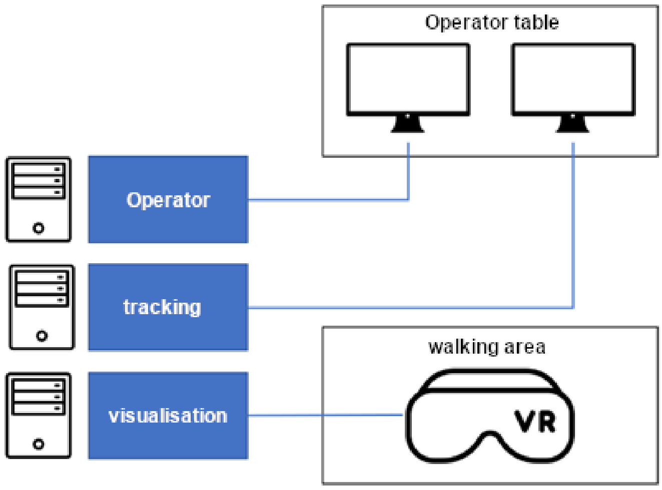

Figure 2-1: Schematic representation of the computer network.

The simulation PCs fulfil at least the following requirements:

- Processor: Intel® Core™ i5-13600K
- 32 GB RAM
- GeForce RTX 4060 or higher (for the render PCs)
- SSD with 500 GB size
- Operating system: Windows 11 Pro
- The simulation PCs fulfil the following functions:
  - Operator
  - Skeleton tracking
  - VR visualisation

A control monitor, a mouse and a keyboard are included in the offer for the operating PC. An additional monitor shows the subject's view. The client shall provide a table measuring at least 1.60 m x 0.80 m for setting up the operator PC and for the co-foam monitor. An earthing point must be provided by the client in the vicinity of the set-up.

The cables between the computer network and the operator desk must not exceed a maximum length of 15 metres. The client must provide an appropriate space for this. The client must provide a 230V line with 16A fuse protection (separately) for the power supply.

Due to the real-time requirement for the PCs, no virus scanner will be set up on the simulator PCs. Therefore, for security reasons, it is recommended to place the PCs on a separate network so that the risk of malware infection is minimized.

3.2 WP2.2.: Software

3.2.1 SILAB Edition

SILAB is developed by WIVW and delivered in the current version 7.2 (see the detailed product descriptions for different editions in the attachment). We recommend SILAB Edition PROFESSIONAL. Scenario design is currently based on German guidelines for road networks. An Italian version will be developed.

3.2.2 SILAB Software Add-on Package HEAD MOUNTED DISPLAY

The pedestrian simulation is to be realised using a head-mounted display. The software modules required for this are included in the HEAD MOUNTED DISPLAY add-on package. In order to visualise the pedestrian to the cyclist on the bicycle simulator, the movements of the test person are recorded by software and fed into the simulation software. In this way, body movements (e.g. raising an arm) are transferred to the simulation. Due to technical limitations, the recorded movement model is only approximate and does not fully correspond to the real movements. In addition, short-term losses in the recording are possible, which may result in unrealistic movements being displayed to the cyclist of the bicycle simulator.

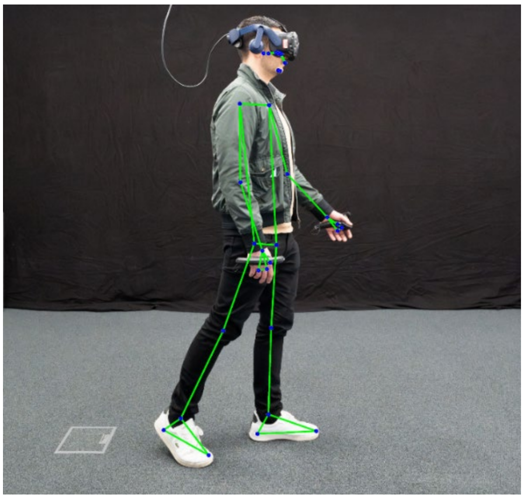

Figure 2-2: Exemplary illustration of skeleton recognition.

The body movement is recorded via skeleton recognition and tracking. Multiple cameras are used to interpolate skeleton data points resulting in depth data (X, Y and Z coordinates) which can be used to visualize the body movements in the simulation. Further, the use of multiple cameras also allows the skeleton to be recognized regardless of the pedestrian's rotation. In general, four cameras will be used for skeleton recognition and tracking.

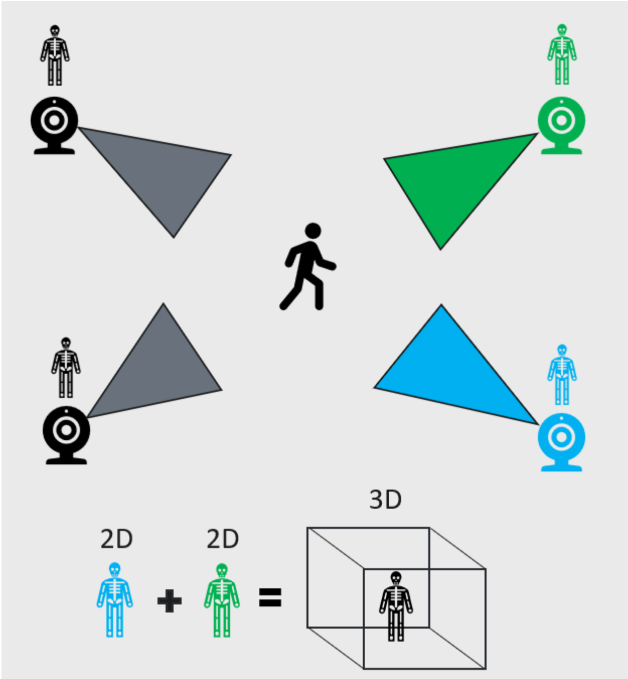

Figure 2-3: Illustration of interpolation of skeleton data.

3.3 WP2.3.: On-site delivery and installation/commissioning

Work package 2.3. includes the delivery of the components and the assembly and commissioning as well as the networking of the bicycle and pedestrian simulator and setting up the Head mounted display package. It can subsequently be used in the following configurations:

- Pedestrian simulator alone
- Simulation together with bicycle simulator

3.4 WP2.4: Instruction and software training

The subject of work package 2.4 is a two-day training course for the client's personnel. This training course deals with the operation of the simulators, the functionalities of the individual software components and the use of the scenario packages included in the scope of delivery. The training takes place on site.

3.5 WP2.5: Support, Care and Maintenance

For a period of one year, starting from the date of acceptance of the system by the client – the WIVW provides services during normal business hours (Monday to Friday, 9 a.m. to 4 p.m. to ensure the operability of the system. Support Requests can be received by e-mail (silab@wivw.de) or by phone (+49 931 78009-400).

Also included in this work package is the maintenance of the respective SILAB Edition software (PROFESSIONAL) for the first two years after commissioning.

Support, care and maintenance services beyond the first two years (e.g. software updates yearly) are not subject of this offer. The current annual costs for support, care and maintenance are €7000 for SILAB Edition PROFESSIONAL and €9000 for SILAB Edition ENTERPRISE. Support, care and maintenance costs are due at the beginning of the term.

4 TIME AND COST PLAN

Schedule

Work can begin immediately after the order is placed. Due to the currently difficult to predict delivery times for hardware components, we expect the project to take about four months. The exact timing is done in consultation with the client.

Cost plan

Work Package	Cost type	€	€/WP
WP1: Bicycle Simulator			
WP1.1: Hardware Setup			
WP1.1.1: Vision system (180° view)			9 210.00
	Hardware	7 650.00	
	Personnel	1 560.00	
WP1.1.2: Mockup			29 160.00
	Hardware	6 760.00	
	Personnel	22 400.00	
WP1.1.3: Computer network			24 890.00
	Hardware	17 450.00	
	Personnel	7 440.00	
WP1.1.4: Hardware: Upgrade to 360° view - optional			16 880.00
	Hardware	14 900.00	
	Personnel	1 980.00	
WP1.1.5 Additional Hardware: Eyetracking and Biosignal Sensors - optional			10 660.00
	Hardware	10 660.00	
	Personnel	0.00	
WP1.2: Software			
WP 1.2.1: SILAB Edition PROFESSIONAL	Software	35 000.00	35 000.00
WP 1.2.2: Upgrade to SILAB Edition ENTERPRISE- optional	Software	15 000.00	15 000.00
WP 1.2.3: SILAB PACKAGE BICYCLE	Software	4 000.00	4 000.00
WP1.3: On-site delivery and installation/commissioning			17 372.00
	Personnel	7 920.00	
	Transport	3 000.00	
	Travel	6 452.00	
WP1.4: Instruction and software training			11 392.00
	Personnel	7 656.00	
	Travel	3 736.00	
WP1.5: Support, Care and Maintenance (first two years)			0.00
	Personnel	0.00	
Sum			**131 024.00**
Sum incl. options			**173 564.00**

Work Package	Cost type	€	€/WP
WP2: Pedestrian Simulator			
WP2.1: Hardware Setup			43 786.00
	Hardware	18 466.00	
	Personnel	25 320.00	
WP2.2: Software			39 500.00
	Software	35 000.00	
	Software	4 500.00	
WP2.3: On-site delivery and installation/commissioning			13 992.00
	Personnel	8 256.00	
	Transport	2 000.00	
	Travel	3 736.00	
WP2.4: Instruction and software training			8 872.00
	Personnel	5 536.00	
	Travel	3 336.00	
WP2.5: Support, Care and Maintenance (first two years)			0.00
	Personnel	0.00	
Sum			**106 150.00**
Total			**237 174.00**
Total incl. options			**279 714.00**

We charge the amount stated in this document for the product offered without tax. It is a tax-free delivery within the EU.

Payment plan:

- After placing the order, the software as well as the dongles will be delivered and charged immediately as well as 50% down payment for the hardware costs.
- After delivery and commissioning all other costs - with the exception of the trainings in WP1.4 and WP2.4 - will be charged.
- After completion of the training for the bicycle simulator (WP1.4) as well as training for the pedestrian simulator (WP2.4) these work packages will be charged.
- 30 days net

5 FURTHER PROJECT CONDITIONS

Certification: WIVW GmbH has been certified in accordance with DIN EN ISO 9001:2015 and ISO/IEC 27001 since 2018.

Project implementation: Implementation is carried out in close contact between the contractual partners. Changes to the scope of the project and project interruptions will result in postponements of the time period and order volume. This must be recorded by mutual agreement.

Warranty and liability: The Contractor shall only be liable for intentional and grossly negligent acts. Liability shall be limited to the amount of the benefits; no liability shall be assumed for consequential damages.

Confidentiality: Insofar as the Contractor uses documents of the Client marked as confidential in the course of carrying out the project, it shall ensure that these documents are treated confidentially by its employees. This also applies to the client.

Place of fulfilment and jurisdiction: Würzburg - Germany.

Offer Validity: 31.03.2025

Veitshoechheim, 17.02.2025

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