The dynamic simulator of the Ural truck driver

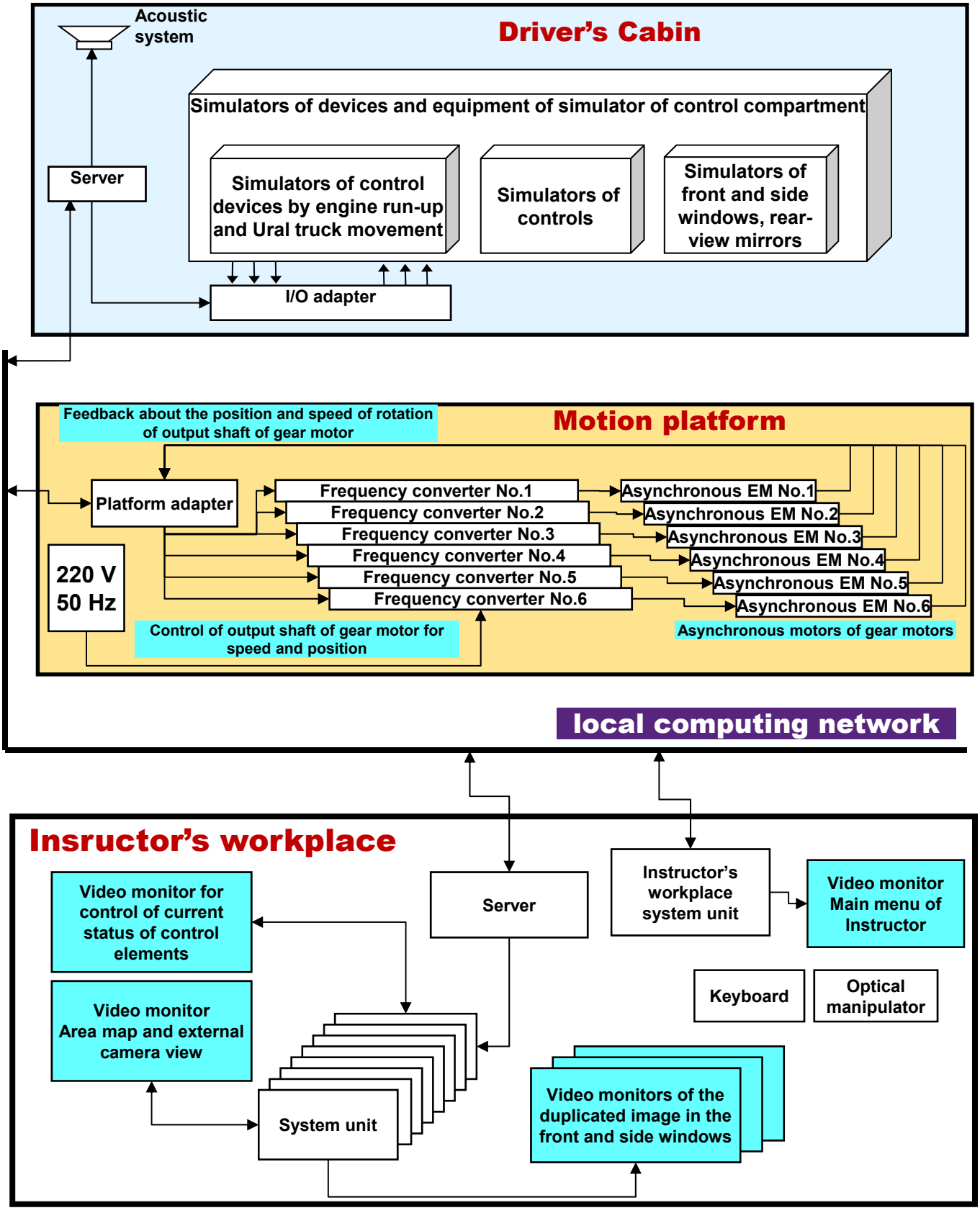
Main characteristics

- Constructive adequacy of the driver's cabin
- Functional adequacy of the simulated Ural truck (correct mathematical model of Ural truck motion, correct algorithms of Ural truck units and assemblies operation)
- High quality of visualization
- 3-D models of training area and terrain
- 6-DOF motion platform
- Full scope of exercises of the Driving Course
- Wide range of training conditions
- Fairness of assessment of trainees actions
- Results documentation

Simulator specifications

No	Specification	Unit of measurement	Specification value
1	Quantity of simultaneously trained people	---	1 (driver)
2	Minimum area of training class	m^2	20
3	Operation readiness after turn-on	min	Maximum 5
4	Duration of continuous work	hour	Minimum 12
5	Electric supply: voltage	V	220±10%
	frequency	Hz	50±1
6	Maximum consumed power	kW	18
7	Range of working temperatures	Deg. C	from +5 to +40
8	Diagnostics system	---	Integrated semi-automatic
9	Size of 3-D model of tank training area	km	4x4
10	Quantity of types of terrain	---	3 (plain, desert, mountain)
11	Assessment of actions of trainees and documentation	---	Computerized, in accordance with indices and criteria of Driving Course
12	Terms of exercises execution	---	Day, night, winter, summer, dust storm, mist, various range of optical visibility, temperature range from -20 grad. to +50 grad.
15	Possibility of BMP-2 equipment failures and faults simulation	---	Enter of failures and faults is implemented from the Instructor’s workplace
16	Failure time	hour	Minimum 500
17	Assigned resource	years	Minimum 8
18	Warranty period	years	2

Simulator Schematic Block Diagram



COMPOSITION OF THE SIMULATOR

1. Full-scale model of the cabin of the Ural truck
2. 6-DOF motion platform
3. Instructor's workplace (include hardware and software)

Full-scale model of the cabin of the Ural track

№	Name	Number, pcs.
1	**Simulators of controls, instruments, kit, incl.**	1
	Instrument panel	1
	Steering wheel with a column, with ignition lock, Switch of turns and illumination, a sound signal	1
	Fuel, clutch, brake pedals	1
	Shift lever	1
	Crane for parking and spare braking systems control	1
	Handle of the cable of the engine stop lever	1
	Manual Fuel Handle	1
	Pre-heater control panel	1
2	**Equipment, kit, incl.**	1
	Battery switch	1
	Driver's seat	1
	Interior lighting	1
	Fan	1
	Video monitor 46" windshield	2
	Video monitor 36" side window	2
	Audio system	1

Motion platform

The simulator uses a 6-DOF motion platform with an electric drive based on asynchronous electric motors with frequency control by position and speed of rotation of the output shaft

The motion platform provides for the reproduction of the oscillations of the tractor cab when driving in accordance with the profile and condition of the track and the speed of movement, as well as acceleration effects during starting, acceleration, braking.

The main characteristics of the motion platform 6PD11

▪Type	Electric
▪Control	Frequency
▪Angle of pitch	+/- 20 degrees
▪Roll angle	+/- 20 degrees
▪Angle of rotation around the vertical axis	+/- 25 degrees
▪The magnitude of the longitudinal displacement	+/- 250 mm
▪The value of the transverse displacement	+/- 250 mm
▪The amount of vertical displacement	+/- 100mm
▪Travel speed according to coordinates (maximum)	20 deg / s
▪Power consumption (maximum)	12 kW

Instructor's Workplace

Functional features
- Choice of training conditions
- Choice of exercises from library
- Generation of new exercises
- Control of trainees actions in course of training
- Diagnostics of technical condition of simulator

Operational assistance to the instructor

Simulator turn on (turn off)

Testing results printout

Instructor's workplace

Assessment for execution of exercise

Input of failures and faults of simulated equipment of Ural track

Mode selection
- Restart
- Training
- Ground situation editor
- Training results

Generation of database of results for certain period

Characteristics of the hardware and software complex of the simulator

✦ Parameters of the mathematical model of the car

►Adequacy of the algorithm for the functioning of devices and equipment simulator in the regular and emergency modes and the reaction of the simulator to the control effects of trainees;
►Adequacy of the model of the Ural track's motion, taking into account the terrain, type of soil, the state of the coating;
►The account of conditions of district, time of year, days.
►Adequacy of dynamic characteristics of moving objects and simulated track.
►Adequacy of visual, sound and dynamic effects of the simulator.

✦ Visualization of the external situation

▼Detailed and depiction of the terrain, the correspondence of the color scale of the image to the real background
▼Correspondence of angular dimensions, shape, color, contrast of local objects, vegetation, obstacles to real objects in the field of view of the driver

View of the site from the cabin

View of a simulated track from an external camera

Specifications

Reliability

The simulator provides reliable operation during the entire period of operation (warranty and post-guarantee periods) of operation

The program for ensuring the reliability of the simulator is based on the following principles:

- development of software solutions excluding software conflicts with the general, as well as with hardware
- repeated verification of developed design solutions
- application of design solutions that ensure long-term operation of mechanical assemblies
- functional and stage wise control of quality of mechanical and electrical assembly of simulators
- use of exclusively proximity sensors of turning angels and motion in the structure of simulator modes (based on the magnetically sensitive circuits)
- application of protection means of PCBs of electronic devices and connector pins from the external environment
- use of computers in the industrial (secured) version
- use of uninterruptable power supplies for computers
- providing necessary thermal regime of simulator equipment
- provision of power supply margin
- manufacturing application of operation experience proved reliable components, incoming inspection

Warranty and service life

- **The warranty period of operation of the simulator is 2 years, subject to observance of the operating rules and maintenance according to the operational documentation.**
- **The service life of the simulator is not less than 8 years, while observing the operation rules and carrying out maintenance and repair according to the operational documentation.**

® The simulator provides continuous work for 12 hours a day

® The operating time of the simulator is at least 500 hours

Educational-methodical capabilities of the simulator for training drivers

Opportunities for training:

- Single driver training
- Joint training of drivers for driving in a convoy (when combining several simulators)

Opportunities for formation of learning conditions:

- Size of the 3D model of the site - 4x4 km
- Types of terrain - mid-intersected, mountainous, deserted (at the request of the customer can be created three-dimensional model of any real section of the terrain measuring 8x8 km)
- Types of roads - unpaved, hard-coated, off-road
- Time of day-day, twilight, night
- Weather conditions - sunny weather, cloudiness, rain, wind of various speeds and directions
- The time of year is summer, winter (according to the requirements of the Customer in
- According to the conditions of the geographical area of employment)

Possibilities for monitoring the activities of trainees using monitor video monitors at the instructor's workplace:

- on the current status of driver's controls and displays
- on the duplicate field of view of the front and side windows of the driver
- according to the state of the simulated vehicle from the point of view of the external controlled camera
- on the position of the simulated car on the motorway track, on the terrain
- on the protocol of driving exercises
- on reports of students on means of communication

Educational-methodical capabilities of the simulator for training drivers

Possibilities for evaluating the actions of trainees

A. Objective evaluation (automated in accordance with the driving standards):

- Actions of drivers on performance of the full list of exercises of a course of driving on an autodrome
- Actions of drivers during driving in urban conditions

B. Subjective assessment of drivers (not automated with respect to the totality of indicators in accordance with the requirements of the Combat Training Program):

- On driving in various road conditions and off-road, and also during driving in a column
- Driving in difficult conditions

Possibilities for processing and storing the results of exercises and training on the simulator

- Documenting of results in electronic form and output of appraisal statements for printing
- Archiving the results of exercises by crews for a school day or for a period of study
- Inclusion of the simulator in the system of centralized accounting and processing of the results of training of the military unit or educational institution

Characteristics of the training process and training of drivers on the simulator

- Ensuring the principle of learning "from simple to complex," the implementation of an individual approach to training, ensuring the continuity of training and driver training
- Organizational and methodical interrelation of trainings and trainings on simulators with practical driving classes at the circuit and in the city
- The objectivity of assessing the level of training of each unit driver, determining the dynamics of acquiring driving skills in different conditions
- Managing the process of training and training, high intensity of training
- Reducing the conventionality of training and training, the approximation of training conditions for drivers to real.