

ROBSIM SOFTWARE FOR MOBILE ROBOTS MODELING

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Abstract

This paper discusses issues of Unmanned Vehicles' (UV) modeling at various stages of their life-cycle. It presents software system RobSim. RobSim has a capacity to develop models of UVs of high complicity and perform modeling of their functioning. The paper describes structure of RobSim software with basic developers' tools including high-level robotic languages programming and control.

Key words: mobile robot, unmanned vehicle, modeling, software, simulator.

Introduction

Mobile robot is a complex system with sophisticated structure. Functional purpose of any mobile robot defines specific requirements for construction, chassis technical ability, attached equipment, and, simultaneously, defines environment properties and work area in which mobile robot should realize all his functional. In order to verify constructive solutions, which generated in robot development, one needs to create big amount of samples that lead to increase of robots cost.

The alternative approach is using computer modeling and 3d visualization of mobile robot and environment. The computer modeling provides estimation of mobile robot effectiveness in certain environmental conditions, defines solutions correctness, decrease amount of experiments, helps to choose optimal plan of robot technological operations execution for one robot and groups of robots. Thus, important task is applying software that provide modeling of mobile robots functioning in environment at various stages of their life-cycle. We presents software system RobSim. RobSim has a capacity to develop models of UVs of high complicity and perform modeling of their functioning.

Functionality of RobSim

Last version of RobSim provides tools for developing various types of mobile robots. The basic functions of RobSim are:

- mobile robot visual and dynamical models creation;
- models of all robot main parts development, such as actuators, sensors, etc.;
- creating environment model;
- development of mobile robots control system with using standard robots algorithms;
- parameters estimation of all subsystems in modeling process;
- modeling of robots groups;
- modeling process observation from any point of 3d scene;
- detailed logs maintenance with ability to play records of modeling process.

The Robsim structure

The Robsim software package includes a number of subsystems presented below.

1. RobSim program shell is a user interface, which provides selecting scenes and robots, participating in the modeling process, and launching the simulation. After launching, the shell loads several subsystems: control system unit, dynamics unit, visualization unit, and provides a centralized data exchange between these subsystems in the modeling process.

2. The control system unit models logic and control interface for mobile robot. The results of the unit processing are transferred to the dynamic unit through the program shell as signals to the executive system of mobile robot.

3. The dynamic unit calculates "robot-scene" state space parameters using its mathematical model. Simulated dynamic elements include bodies, hinges, approximating contact containers, linear and rotary motors, wheels with different types of suspensions, interchangeable tools, sensors, etc. As a result of the dynamics calculation, position and orientation of the scene elements are generated, which are then transferred to the visualization unit via the program shell.

4. The visualization unit provides high-quality visualization of virtual 3d scenes. The unit supports the visualization of surfaces with complex materials, including textures of reflection, transparency and relief; allows you to simulate realistic lighting with the generation of shadows based on shader technology and effects such as flame, smoke and water.

3D model creation

The main platform for creating 3D models of robots and scenes is Autodesk 3DStudio Max (3DSMax). Developer can use standard components of 3DSMax to create the model. In addition, a plug-in has been developed that has a specific set of tools. In particular, with the help of the plug-in, it became possible to model main components of the robot: chassis suspension, wheels, caterpillars, grippers, manipulators, etc.

The plug-in provides physical parameterization of robots and scenes models (mass-inertial characteristics, type of surfaces, parameters of engines, brakes, etc.). Figure 1 shows mobile robots in the working area and their models in Robsim.

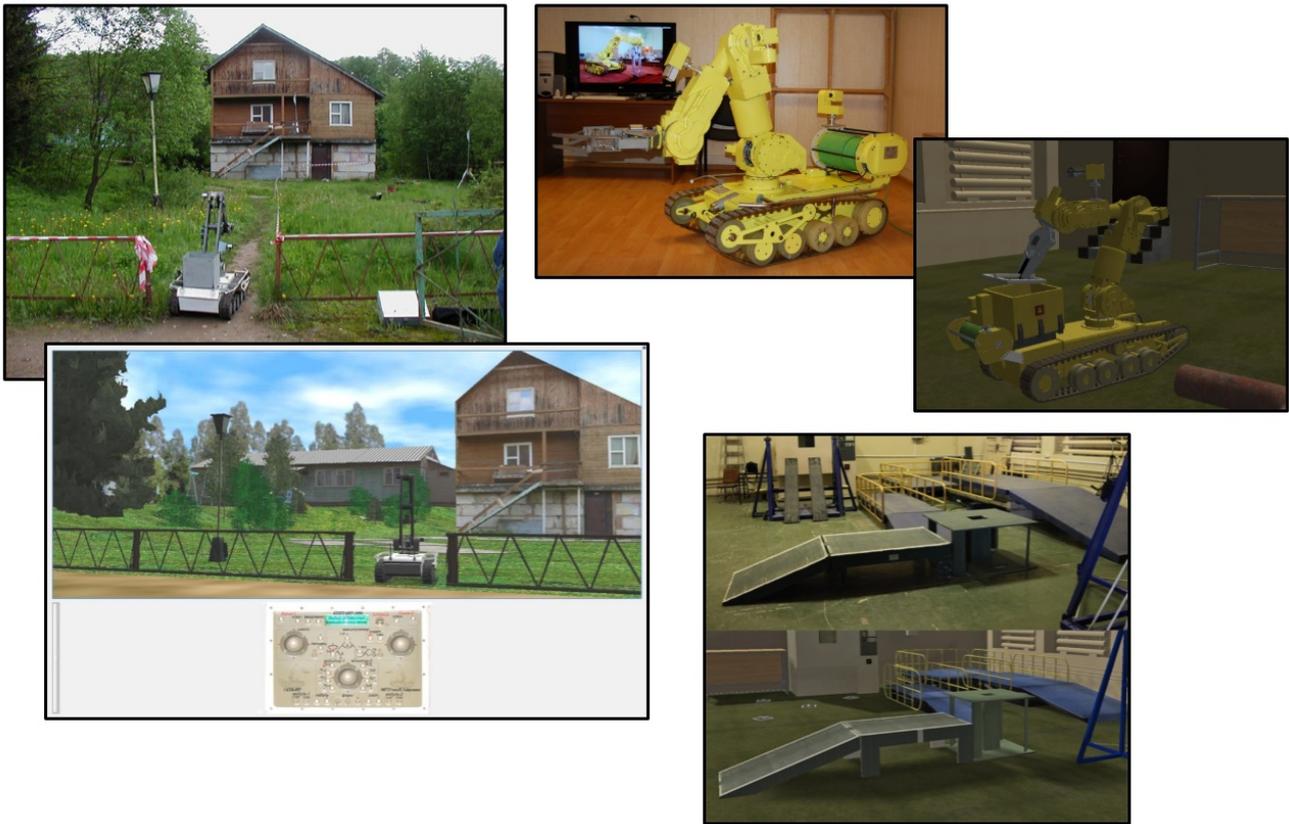


Fig.1. 3D scenes.

The modern robots field of application includes work in extreme environments, in particular: decontamination of radioactive materials, fire extinguishing, etc. In order to take into account such operations in the modeling process, Robsim implemented a number of tools:

- complex dynamic processes modeling, including a large number of complex objects interaction (blockages modeling);
- dismantling blockages modeling;
- smoke, flames, fire extinguishing systems modeling (figure 2).

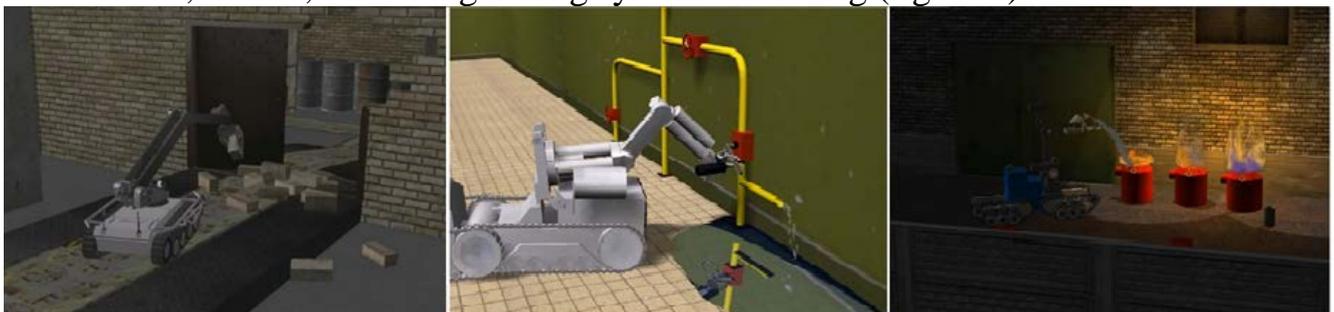


Fig. 2. Effects.

Control system modeling

A special editor CtrlPanel was developed for control system modeling. The Robsim software provides both a virtual control using control panel model and a real control via remote control desk.

The virtual robot control panel consists of two parts: interface and algorithmic. The interface part is a set of virtual controllers: joysticks, buttons, etc. The algorithmic

part embodies the control system structural diagram in form of logical connections between controllers and execution mechanisms.

RobSim realizes possibility of developing user blocks for the control system. These blocks are used in conjunction with standard blocks from the library, and allow the developer to describe the blocks logic in a high-level language. Each block connects as plug-in to the control panel editor.

Training mode

RobSim software can be used both for modeling and as a simulator and for training operators of real-world robots.

Using RobSim as simulator allows operators to:

- master the basic techniques of robot control, including work with attachments;
- improve skills of working with robots in various conditions (overcoming obstacles, working in a limited space, moving various objects, etc.);
- improve interaction between operators of various robots using the network training;
- planning tactics of robots work under certain conditions.

Conclusion

Simulation is an important tool used at different stages of the robot life cycle. The development of universal modeling systems applicable for various types of robots is an important task of robotics.

RobSim gives a powerful tool that allows simulating the functioning of different robot types in different environments when performing various tasks.