

USER MANUAL FOR SOFTWARE PRODUCT «1K62 LATHE SIMULATOR»

Brief Description of the Software Product

3D simulator of a classic screw-cutting lathe machine mod. 1K62. The application simulates the performance of ordinary turning operations in an interactive mode. The capabilities of the simulation model include operations of external and facing turning, drilling and boring of holes, turning of grooves, cutting of external and internal threads. In the full version of the application, more than 70 cutting tools are available for work. The graphical user interface is made in Russian and English. Metric and inch measurement systems are supported. The required amount of video memory of the device is 350 MB. The graphical system of the application uses the components of OpenGL 3.0.

Main Screen Elements

The main screen of the application is represented by a 3D scene depicting a geometric model of a 1K62 lathe in an abstract spatial environment (Fig. 1). The main control elements are displayed on the screen - buttons and measuring scales of the feed limbs of the lathe.

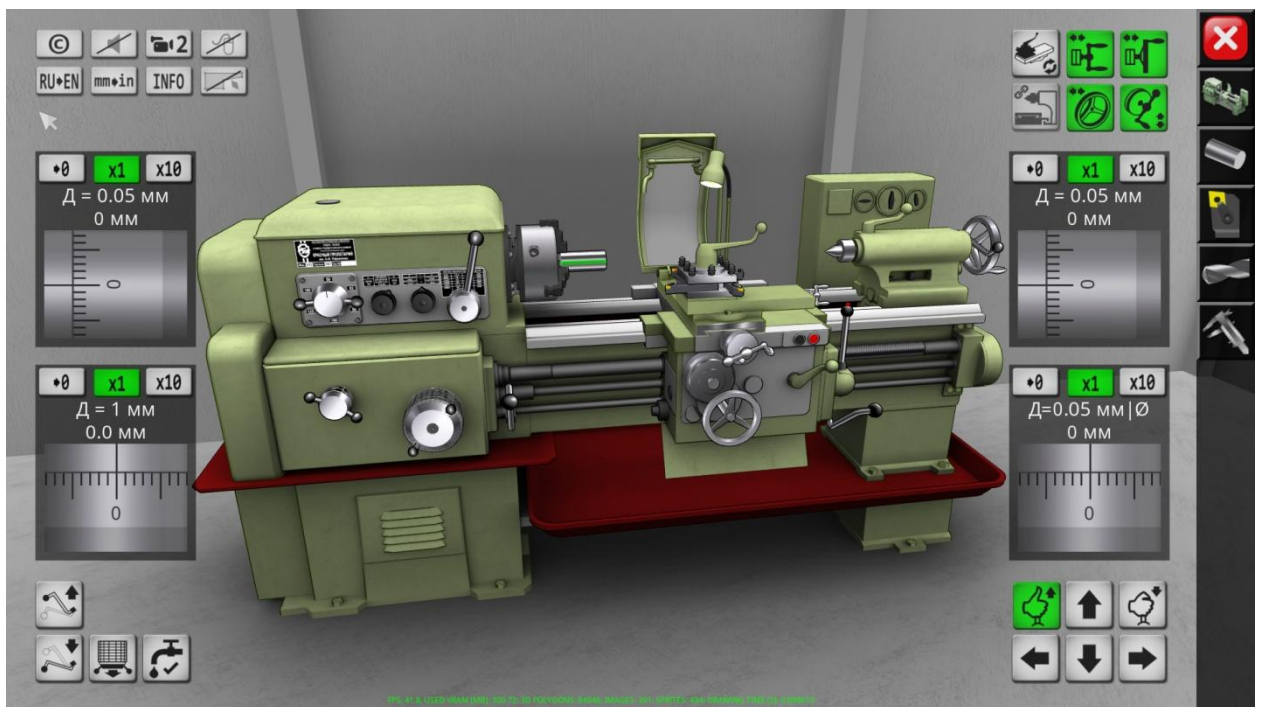





Figure 1 – Main Screen of Application

On the right side of the screen are the main function buttons of the application. The first (top to bottom) button  is designed to exit from application with confirmation. The second button  displays on the main screen a scheme of a screw-cutting machine 1K62 with the designation of the main nodes (Fig. 2). The third button  opens the control panel for the workpiece parameters (Fig. 3). In this 3D scene is displayed in the background with the ability to manipulate the camera.

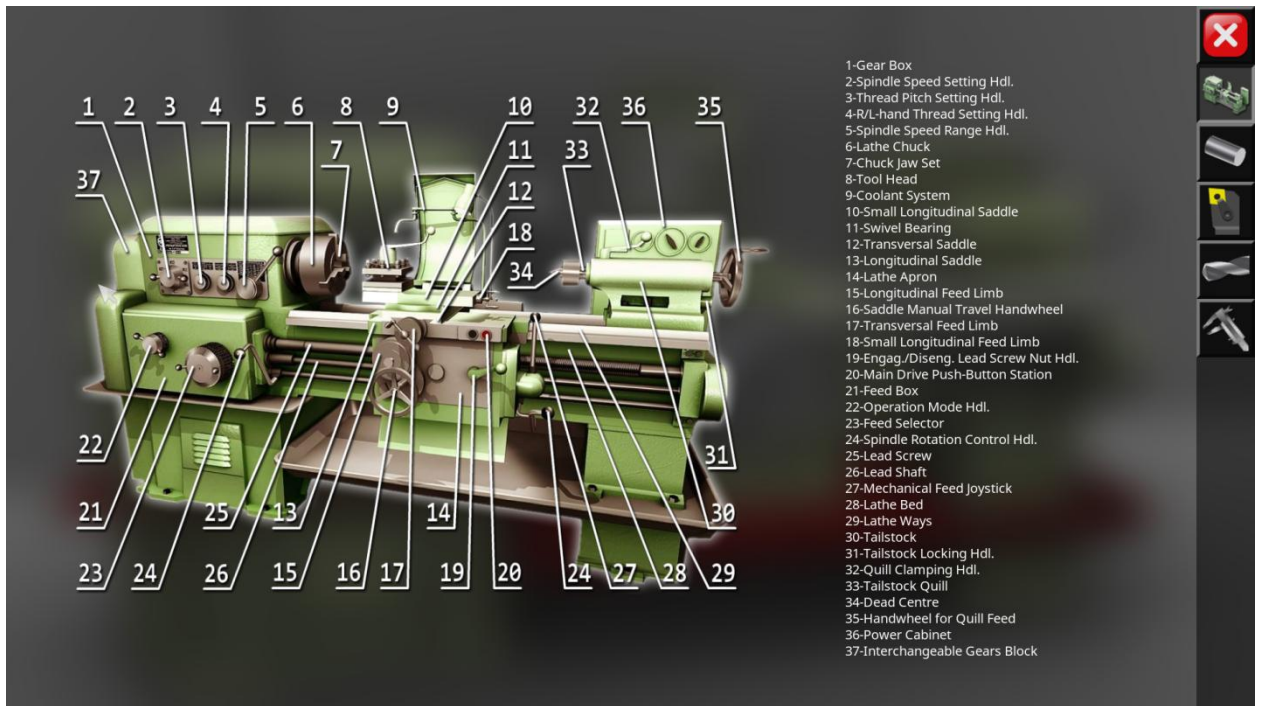


Figure 2 – Machine Scheme

The workpiece parameters control panel contains three numeric fields with buttons for changing values \pm : «Length», «Diameter» и «Departure». The dimension of the parameter values corresponds to the selected measurement system (metric or inch). The parameters are changed according to the limit values allowed for this simulation model.

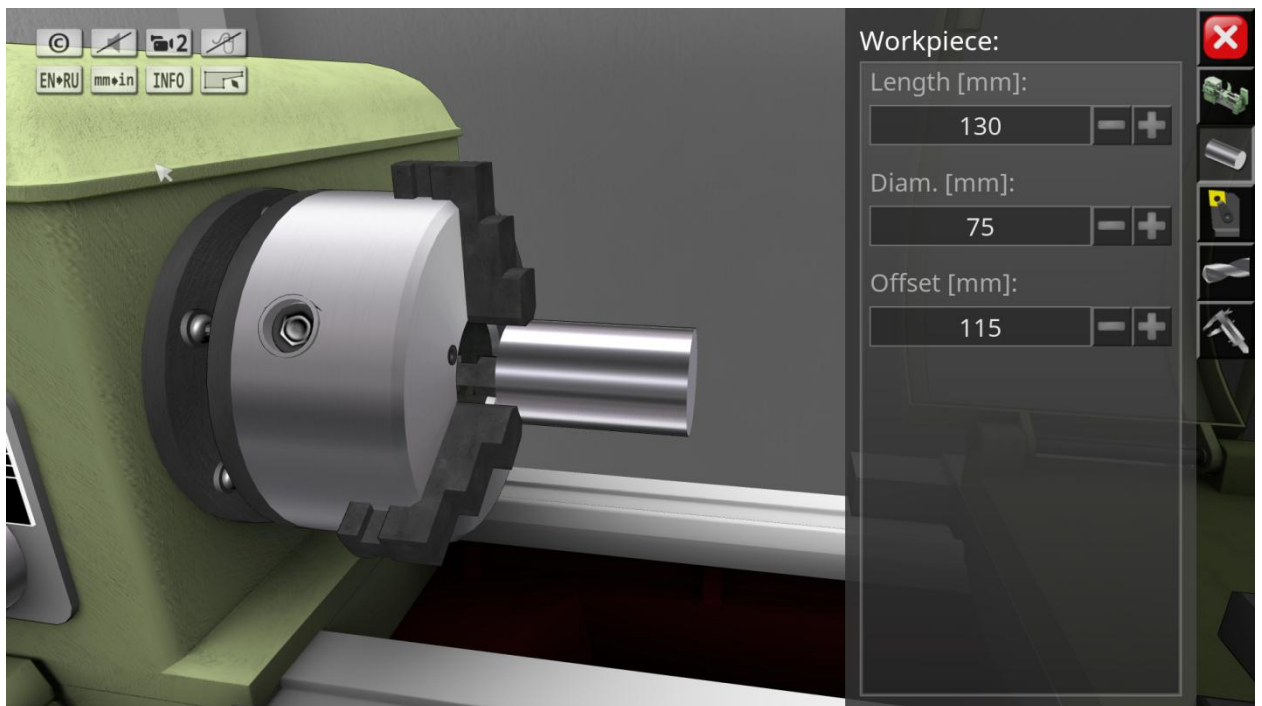



Figure 3 – Workpiece Parameters Control Panel

The fourth button with the image of the lathe tool  opens the control panel for the parameters of the tool installed in the four-position tool post of the lathe (Fig. 4).

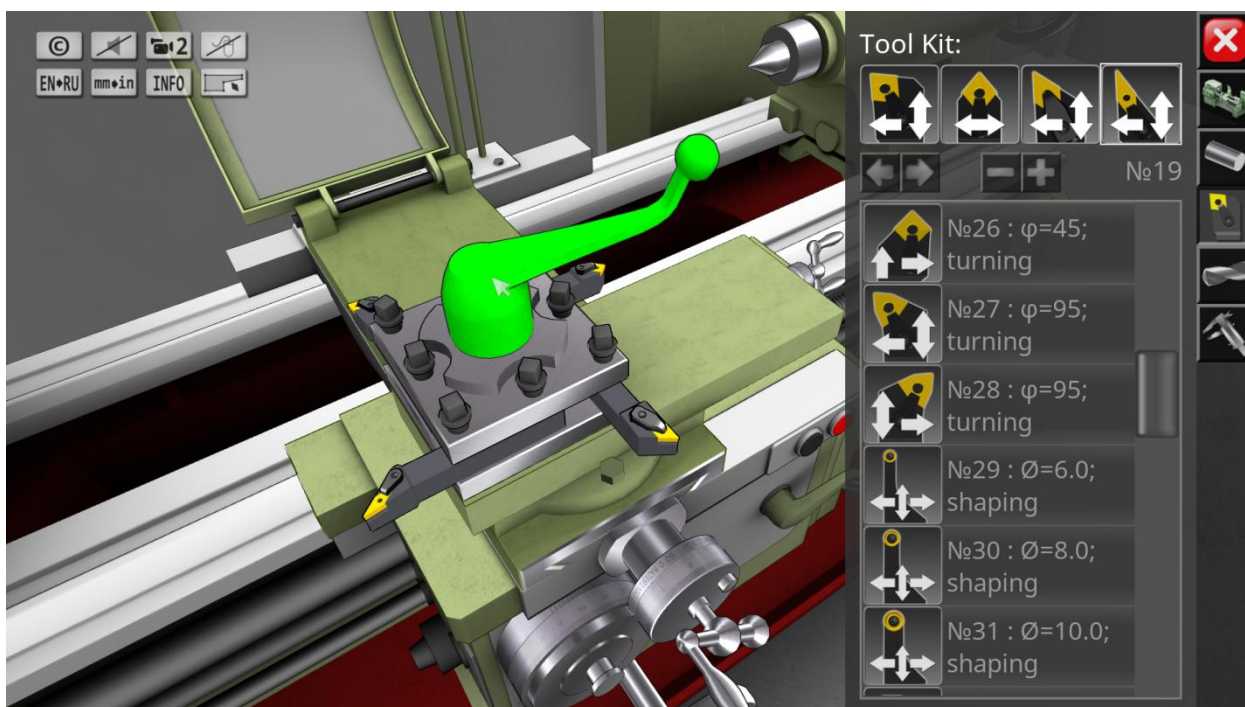






Figure 4 – Tools Parameters Control Panel

At the top of the control panel, there are four square cells whose indexing corresponds to the positions of the lathe tool holder. Below the tool holder positions block, there are buttons for switching the current custom position  , as well as buttons for changing the tool departure  . The main part of the control panel contains a list of available cutting tools with their brief description and the value of the main angle in the plan. To add a tool to one of the tool holder positions, drag the tool icon from the list to the desired cell at the top of the panel. The tool is extracted from the tool holder position in the reverse order, and the returned tool is simply dragged to any part of the tool list field. In the process of setting the tool parameters, the tool holder can be rotated by clicking on the 3D model of the shaped handle (Fig. 4). If the computing device is equipped with a mouse, the model of the tool holder handle is highlighted in bright green when the mouse pointer is hovered over it.



The fifth button with the image of the drill  opens the control panel for the tool parameters of the tailstock of the lathe (Fig. 5), while the simulator uses two types of equipment – the dead center and the drill chuck. For the implementation of face drilling operations, drill bits of 12 different diameters are used. In the upper part of the control panel of the equipment parameters of the tailstock of the machine there are two radial switches, with which the type of equipment is selected. The following two numerical fields relate to drill parameters. In this case, you can change the diameter of the current drill installed in the drill chuck, as well as its departure.



Figure 5 – Tailstock Tools Parameters Control Panel

The sixth button with the image of a caliper  displays the contour of the workpiece on the main screen with the ability to measure the length and diameter at any point of the contour (Fig. 6). To get the main dimensions at any point of the contour, you need to move the markers with images of the letters «L» and «D» in the longitudinal and transverse directions of the screen, respectively.

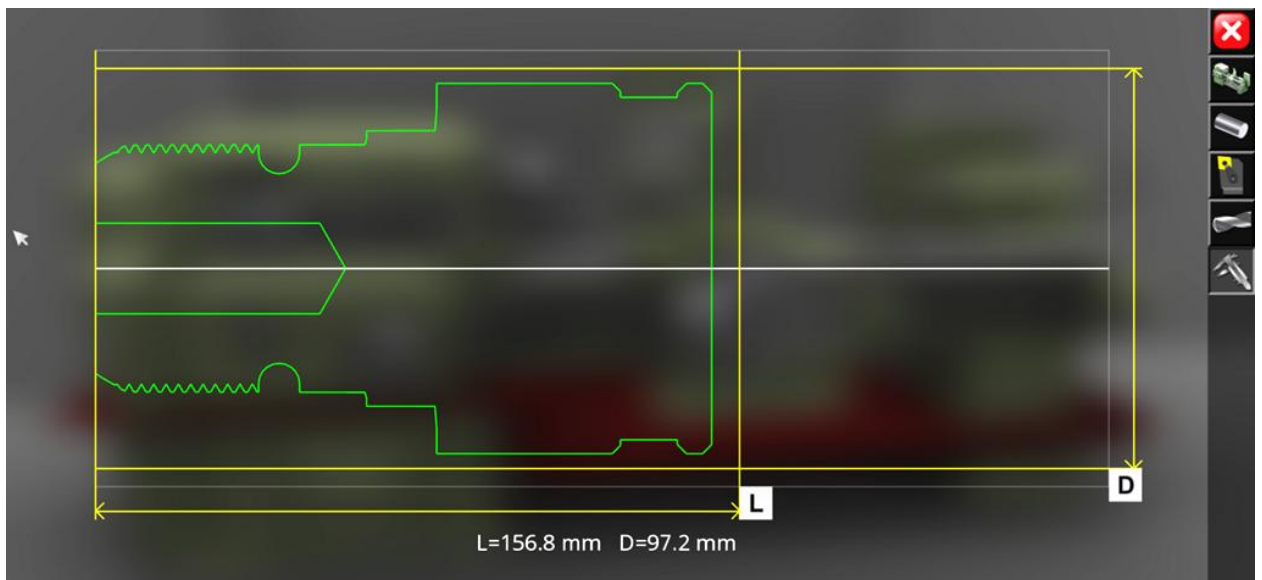


Figure 6 – Workpiece Contour Screen

To hide the full-screen dialog or control panel, you must press the call button for this dialog or control panel again.

In addition to the side panel with the main function buttons, there are groups of buttons on the main screen for setting up the application, as well as buttons for

controlling the lathe. In the upper-left part of the screen, there are buttons for the main settings of the app (Fig. 7).

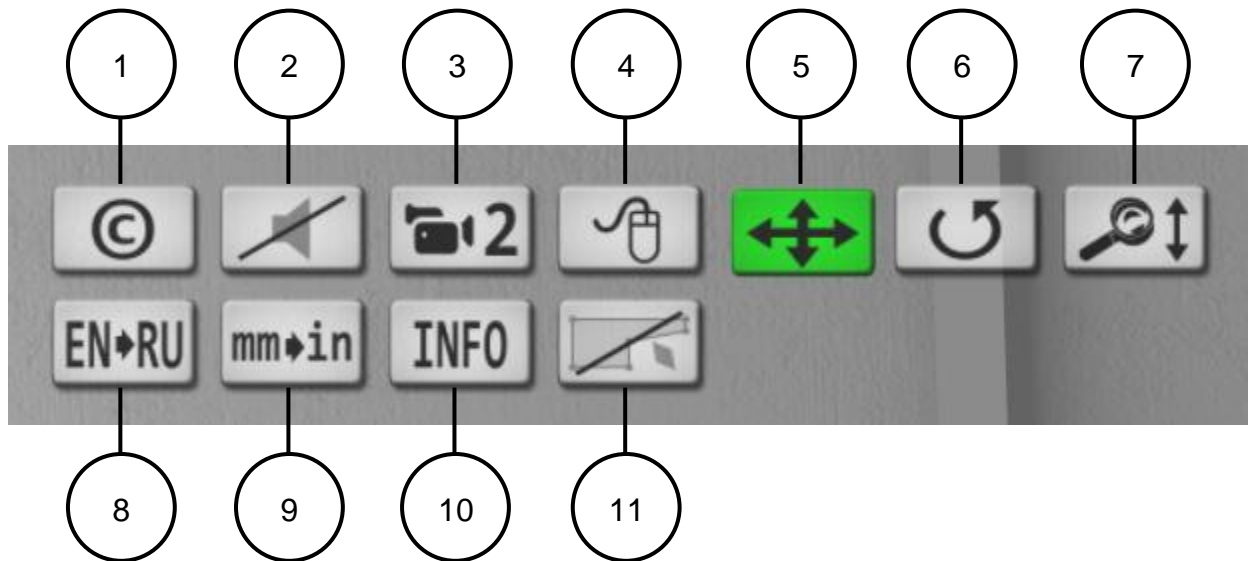


Figure 7 – Main Settings Buttons

Button 1 displays basic information about the app on the screen, including the version of the app, type of license used, and contact information for contacting the developer.

Button 2 is used to disable and re-enable the sound.

Button 3 is used to switch the camera mode. In this case, the simulator uses two camera modes – the free camera positioning mode (№1) around the machine and the stationary camera mode (№2), in which the camera is tied to the top of the current cutting tool.

Button 4 is displayed on the screen of devices equipped with a mouse. Clicking this button disables (or re-enables) camera control using a computer mouse. This feature can be useful when working with interactive whiteboards or tablet computers running Windows, where you can touch the screen and control the mouse.

Buttons 5, 6, and 7 are displayed when you disable mouse control of the camera, and on devices that do not have a computer mouse, these buttons are displayed permanently on the screen. Button 5 enables the planar offset of the camera. Button 6 enables the camera to rotate around the focus point. Button 7 enables the zoom mode (in/out) of the camera relative to the focus point. In the camera touch control modes (5, 6, 7), all manipulations are performed by touching and moving your finger on the device screen.

The 8 button is used to switch the app's language settings. The current version of the app supports English and Russian languages. Language settings affect all graphical interface texts, as well as text labels on the 3D model of the machine.

Button 9 is used to switch the measurement system. The simulator supports metric and inch measurement systems. In this case, all the dimensional parameters of the simulation model correspond to the current selected measurement system.

The 10 button is intended for displaying/hiding the main technological parameters on the main screen – processing mode, feed speed, spindle speed, etc.

Button 11 is used to display/hide the contours of the workpiece and the cutting tool. Displaying contours can be useful when processing the internal surfaces of a workpiece to visually control the location of the tool relative to the surface.

In the upper right part of the screen, a group of buttons is displayed for enabling/disabling the manual feed bars of the lathe, as well as for adjusting the angular position of the small longitudinal feed saddle of the machine, and the button for enabling the mode of rigid coupling of the tailstock with the longitudinal saddle of the machine (Fig. 8).

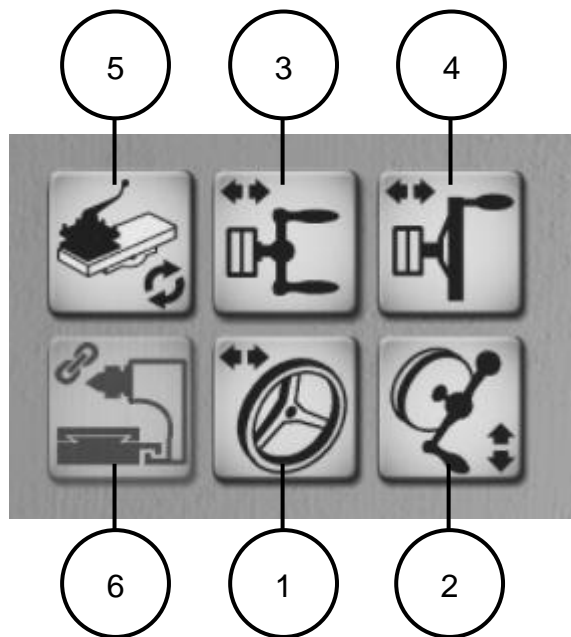


Figure 8 – Buttons for Display/Hide Panels of Manual Feed Handles of the Lathe

Buttons 1, 2, 3, and 4 are designed to display/hide on-screen control panels for manual feed limbs: large longitudinal, transverse, small longitudinal, and tailstock pinole feed, respectively. The manual feed limb control panels are displayed on the main screen on the left and right sides of the screen.

Control panels are built on the same principle. The main part of the panel is occupied by a cylindrical scale of the limb, graded according to the currently selected measurement system (Fig. 9). Above the scale, the price of the limb division (D) and the current value displayed on the scale are displayed. In the upper part of the panel, there are three functional buttons – the zero limit button «0», the normal rotation mode button «x1» and the accelerated rotation mode button «x10».

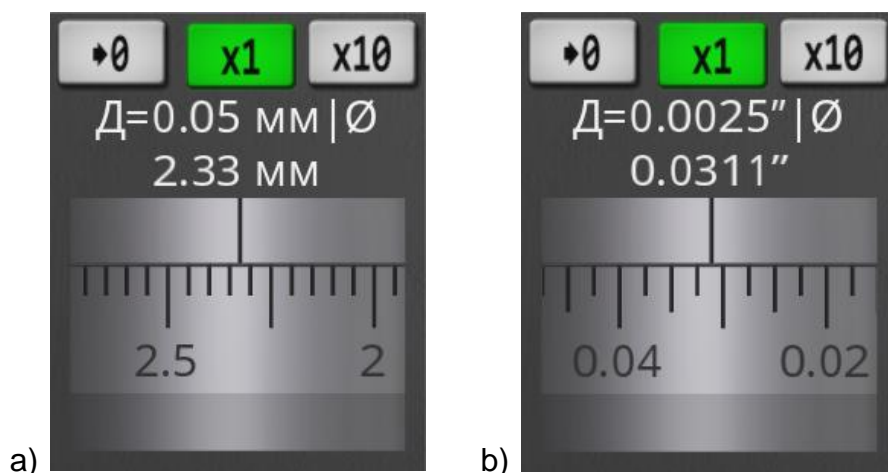


Figure 9 – Cross Feed Limb Control Panel with Scale Image in Metric (a) and Inch (b) Measurement Systems

Simulation of the rotation of the manual feed flywheel is performed by shifting the scale of the limb in the direction of its calibration. It is possible to rotate at a constant speed. To start the rotation of the mouse (or finger for touch) need to put in the scale field of the limb and clicking the left mouse button (tap for touch), start steady shift in scale.

When performing mechanical feeds, manual control of the limbs becomes unavailable.

Button 5 (Fig. 8) displays a mini-panel on the screen with the parameter of the angular position of the small longitudinal feed support of the machine (Fig. 10).

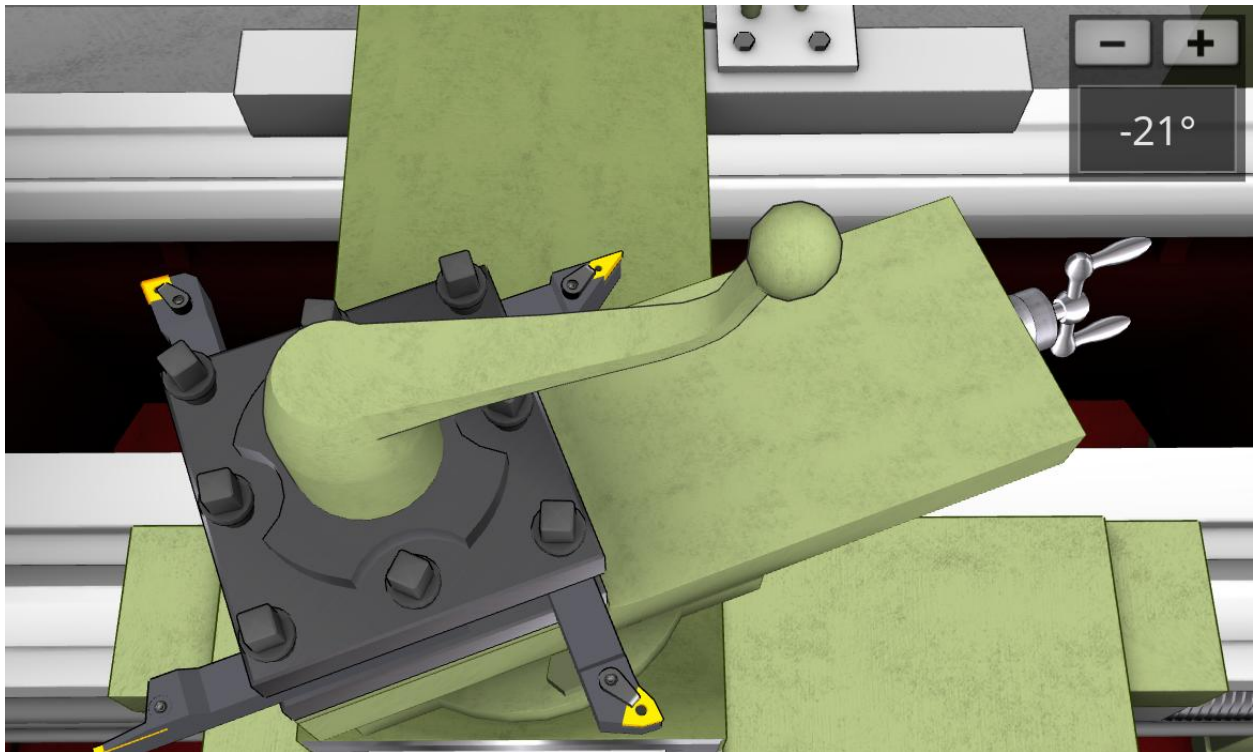


Figure 10 – Control Panel for the Angular Position of the Small Longitudinal Feed Caliper of the Machine and the Type of Caliper when it is Rotated

Button 6 is designed to enable the mode of rigid coupling of the tailstock with the longitudinal support of the machine. This button becomes active if a drill Chuck with a drill bit is installed in the tailstock pinole, and the longitudinal caliper is moved to the right at a safe distance from the workpiece. This function simulates the rigid engagement of the tailstock and caliper of the machine using a special device (not shown in the simulation model) that provides mechanical movement of the tailstock on the working feed for the purpose of drilling end holes. In the rigid coupling mode, the cross caliper is automatically moved to the nearest position, and the control of the cross caliper is blocked. In this case, it is possible to move the longitudinal support of the machine manually or mechanically.

In the lower-left corner of the screen, there is a group of buttons for auxiliary control of the lathe (Fig. 11).

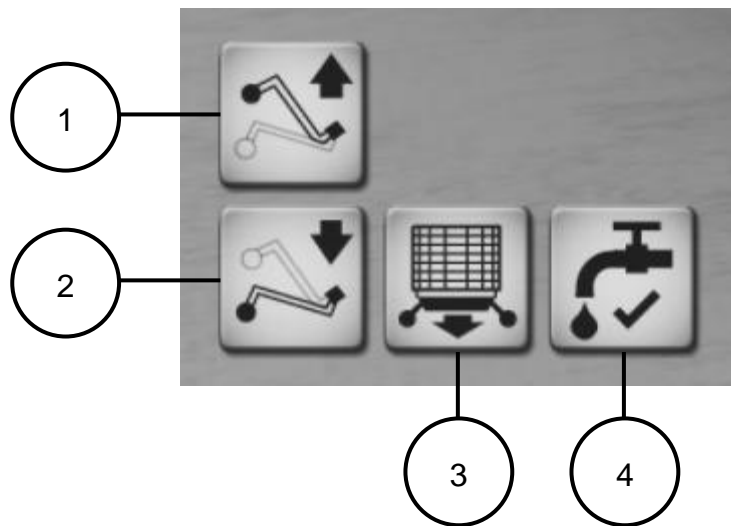


Figure 11 – Additional Lathe Control Buttons

Buttons 1, 2 are designed to change the position of the handle of the direction of rotation of the machine spindle. The handle for changing the direction of rotation of the spindle has three positions – «Up», «Neutral» and «Down». In the «Up» position of the handle, the spindle rotates in the forward direction. The «Down» position of the handle corresponds to the reverse rotation of the spindle. The neutral position of the handle stops the rotation of the spindle.

Button 3 is used to change the state of the feed selector located on the feed box of the headstock of the lathe. When the button is pressed, the internal feed selector dial is pushed out, allowing you to switch the feed rate within the set range.

Button 4 is used to turn on/off the coolant supply.

The group of buttons in the lower-right corner of the screen is used to control the mechanical feed joystick (Fig. 12). Button 1 enables the movement mode on the working feed, and button 2 – the movement mode on the accelerated feed, respectively. Buttons 3 are used to change the direction of the mechanical feed.

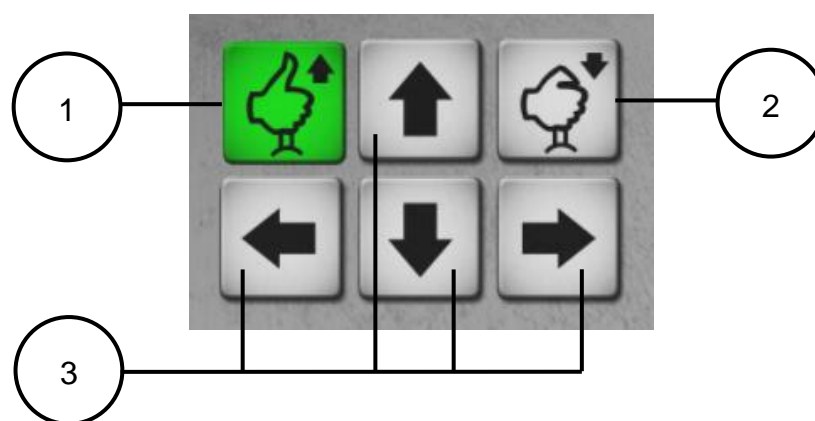


Figure 12 – Mechanical Feed Joystick Control Buttons

Control the Camera with a Computer Mouse

Camera mode №1 is controllable. The camera moves in a spherical coordinate system around the focus point (Fig. 13). The camera's focus point can move in the vertical front plane of the model space. In addition, the camera can distance itself from the focus point to an arbitrary distance limited by the size of the space.

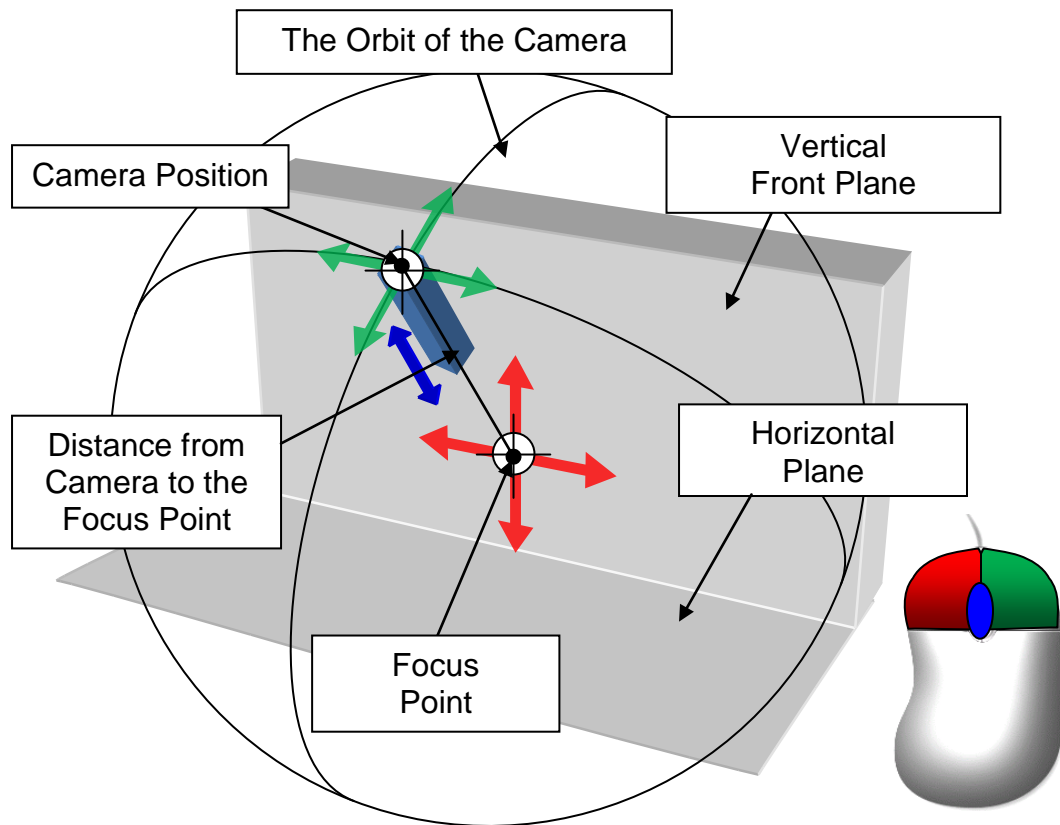


Figure 13 – Camera Control in Mode №1 with Mouse

The main manipulations with the camera in mode №1 are performed using a computer mouse. In this case, pressing and holding the left mouse button with the accompanying mouse movement causes the camera's focus point to move in the front plane of the space. Pressing and holding the right mouse button with the accompanying mouse movement causes the camera to rotate relative to the focus point. The camera's rotation angles (azimuth and elevation) are limited by the dimensions of the model's space. Changing the camera distance is performed by rotating the scroll wheel in the forward and reverse directions.

Interactive Lathe Control

The main manipulations with the lathe controls are performed interactively by clicking on the elements of the 3D model of the machine. If the device is equipped with a computer mouse, when you hover the mouse pointer over the machine control, this element is highlighted in bright green (Fig. 14). When using touch control, objects are not highlighted with color.



Figure 14 – Interactive Selection of a Lathe Control

For the most effective interaction with a particular machine control unit, it is necessary to bring the camera closer to the controlled element, and position it so that the controlled element is in the center of the screen.

Some interactive controls duplicate the functions of previously described on-screen buttons, such as the mechanical feed joystick control buttons. Thus, to switch the joystick position, you can click in the areas around the joystick handle (Fig. 15). Clicking on the 3D model of the joystick handle itself switches the movement mode (on working or accelerated feeds).

Similar interactive manipulations are performed with all the main machine control elements – the speed box handles, the feed box handles, the spindle rotation direction handles, the start/stop buttons of the main machine drive, the tailstock elements, the coolant supply tube, etc.

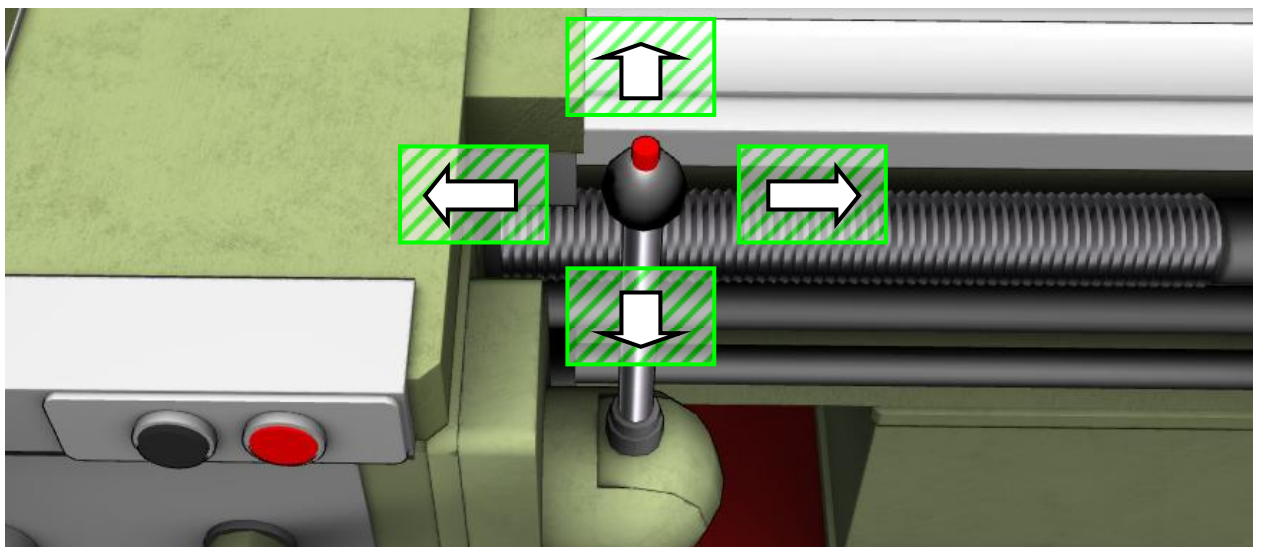


Figure 15 – Click Areas Around the Handle of the Lathe's Mechanical Feed Joystick

On devices equipped with a physical keyboard, it is possible to control the moving elements of the machine using the alphanumeric keyboard keys. The table shows the main keys and their functions.

Table – Keys for Controlling the Movable Elements of the Machine

No	Key	Action
1	W	Manually moving the saddle forward of the transverse (manual cross feed)
2	A	Manually moving of the longitudinal saddle to the left (manual longitudinal feed)
3	S	Manually moving of the cross saddle back (manual cross feed)
4	D	Manually moving of the longitudinal saddle to the right (manual longitudinal feed)
5	Z	Manually moving of the small longitudinal saddle to the left (manual small longitudinal feed)
6	X	Manually moving of the small longitudinal saddle to the right (manual small longitudinal feed)
7	C	Manually moving the tailstock pinole to the left
8	V	Manual movement of the tailstock pinole to the right
9	Up	Joystick of mechanical feed forward
10	Left	Joystick of mechanical feed to the left
11	Down	Joystick of mechanical feed back
12	Right	Joystick of mechanical feed to the right
13	Space	Mechanical feed mode (working/accelerated)
14	Shift	Handle for the direction of rotation of the spindle up
15	Control	Handle for the direction of rotation of the spindle down

Minimum System Requirements

- CPU: Intel / AMD, at least 2 GHz.
- RAM: at least 1 GB.
- Video memory: at least 350 MB.
- Screen resolution: at least 1024x768x32.
- DirectX 9.0.c (for Windows OS).
- Support for OpenGL 3.0.
- Standard keyboard and computer mouse with scroll wheel.
- Sound reproduction tools (audio speakers or headphones)..

Main Information Resources

Website «Virtual Laboratories & Technical Simulators»:

<https://virtlabs.tech/1k62-lathe-machine-simulator>

Community on the VKontakte Social Network:

<https://vk.com/cncsimulator>

Community on the FaceBook Social Network:

<https://www.facebook.com/groups/CNCsimulator>

Instagram page:

https://www.instagram.com/technical_simulators/

YouTube Channel:

<https://www.youtube.com/channel/UCICCOBvRGK6jgL6n2yJIFow>