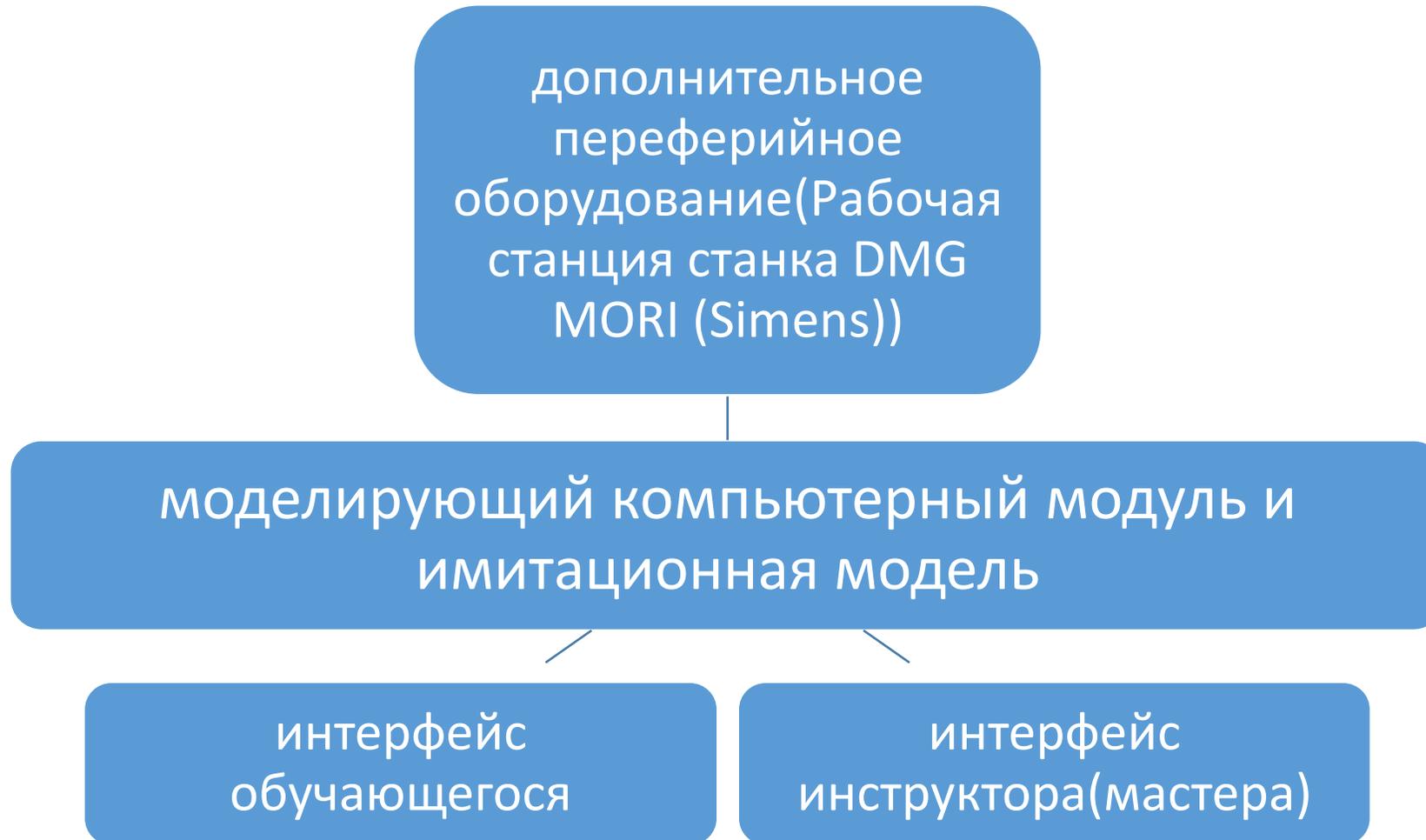


*Применение цифровых инструментов  
для достижения результатов обучения:  
работа с симулятором  
при освоении профессии 15.01.38 Оператор-  
наладчик металлообрабатывающих  
станков*

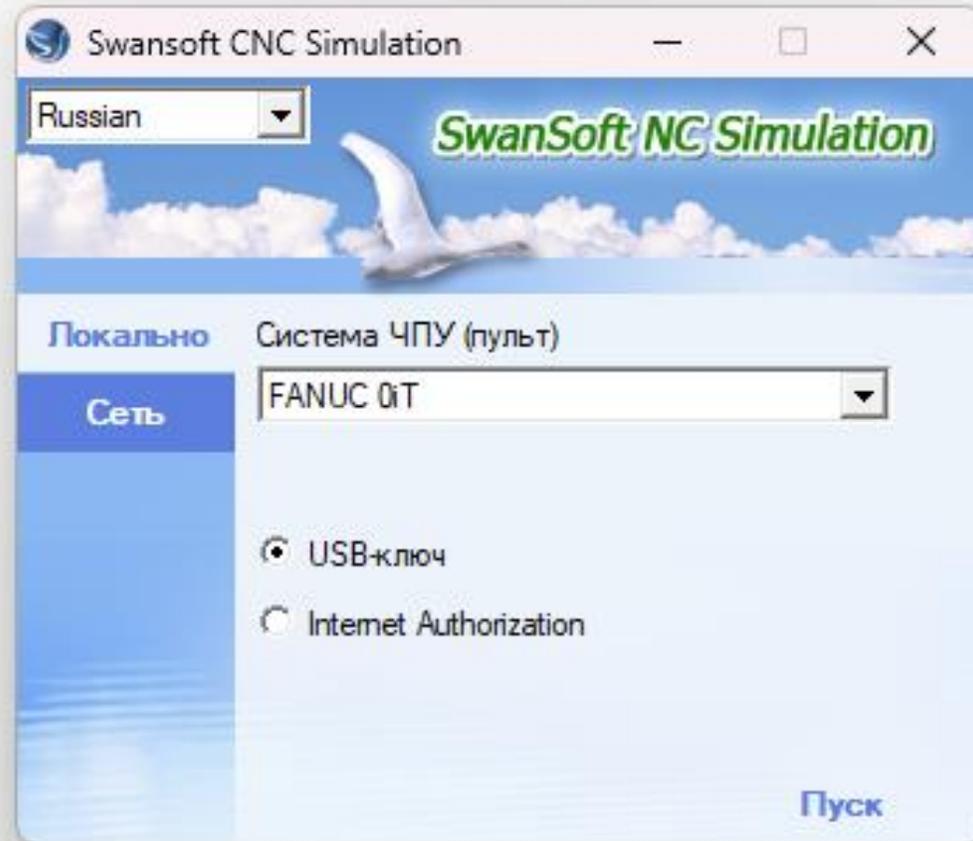
*Мостицкий Федор Федорович  
Кудряшов Александр Викторович*

*ГПОУ ЯО Угличский индустриально-  
педагогический колледж*

# Схема структурных элементов симулятора



# Стартовая страница тренажёра



Russian

SwanSoft NC Simulation

Локально

Система ЧПУ (пульт)

Сеть

FANUC 0iT

SINUMERIK 802DT

SINUMERIK 810/840D M

SINUMERIK 810/840D T

EZMotion-NC 60 M

EZMotion-NC 60 T

EZMotion-NC E68 M

EZMotion-NC E68 T

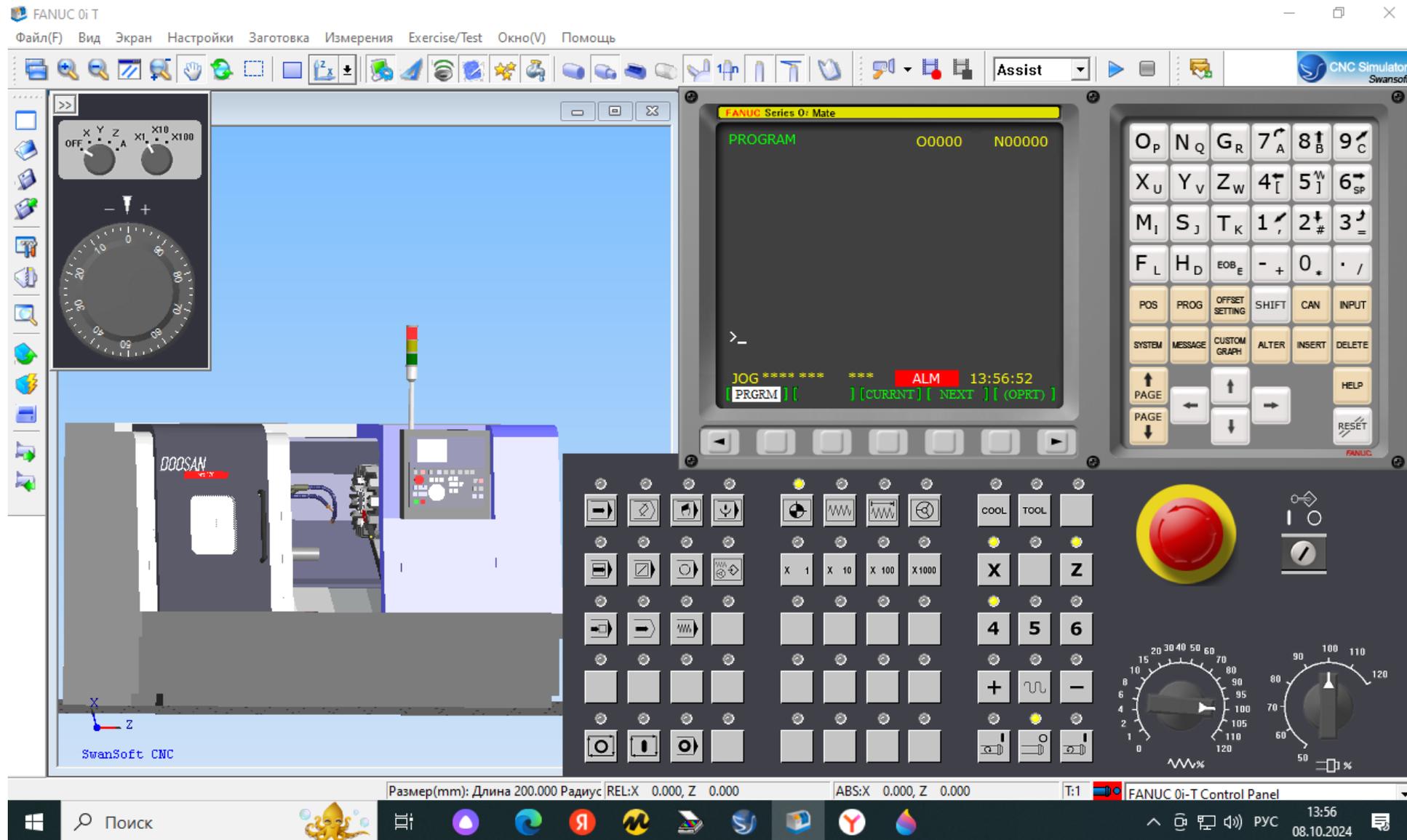
MITSUBISHI M70 M

MITSUBISHI M70 T

FAGOR 8055 M

FAGOR 8055 T

# Общий вид панели симулятора



# Выбор заготовки

The image displays the FANUC Oi-T CNC simulator interface. The main window shows a 3D model of a lathe with a workpiece being machined. The workpiece is a cylindrical part with a diameter of 80 mm and a length of 200 mm. The material is specified as 08F Low carbon steel. The interface includes a menu bar, a toolbar, and a control panel with various buttons and dials. The status bar at the bottom shows the current dimensions and coordinates.

**Параметры заготовки**

Материал детали: 08F Low carbon steel

Длина: 200

Диаметр: 80

Отверстие: 0

Размеры: Заготовка из файла

Вариант крепления:

- Изменить заготовку
- люнета
- Задний центр

Ок Отмена

Размер(mm): Длина 200.000 Радиус REL:X 0.000, Z 0.000 ABS:X 0.000, Z 0.000 T:1 FANUC Oi-T Control Panel 13:55 08.10.2024

# Библиотека инструмента и инструментальный магазин

The screenshot displays the FANUC Oi-T CNC simulator interface. The main window shows a 3D model of a workpiece being machined. Overlaid on this are two windows: 'Библиотека инструментов' (Tool Library) and 'Магазин' (Tool Magazine).

**Библиотека инструментов (Tool Library) Table:**

№	Тип	Длина	Диаметр	Ширина	Insert B...	Insert T...	Ради...	Материал
001	Проход...	160.000	--	30.000	12.000	3.000	0.200	High-spee...
002	Проход...	160.000	--	30.000	12.000	3.000	0.200	High-spee...
003	Отрезн...	160.000	--	20.000	12.000	3.000	--	High-spee...
004	Внутре...	160.000	--	15.000	8.000	3.000	0.200	High-spee...
005	Резьбо...	160.000	--	30.000	3.000	3.000	--	High-spee...
006	Проход...	160.000	--	30.000	12.000	3.000	2.000	High-spee...
007	Контур...	160.000	--	30.000	12.000	3.000	0.200	High-spee...
008	Сверло	160.000	20.000	--	--	--	--	High-spee...
009	Резьбо...	160.000	--	12.000	3.000	3.000	--	High-spee...
010	Расточ...	160.000	--	10.000	6.000	3.000	--	High-spee...

**Магазин (Tool Magazine) Table:**

№	Номер ...
01	001
02	
03	
04	
05	
06	
07	
08	

The interface also includes a virtual control panel with a keypad (O, N, G, 7, 8, 9, X, Y, Z, 4, 5, 6, M, S, T, 1, 2, 3, F, L, H, D, EOB, -, +, 0, ., /, POS, PROG, OFFSET SETTING, SHIFT, CAN, INPUT, SYSTEM, MESSAGE, CUSTOM GRAPH, ALTER, INSERT, DELETE, PAGE, HELP, RESET) and two analog dials for speed and feed rate. The status bar at the bottom shows dimensions: REL: X 0.000, Z 0.000 and ABS: X 0.000, Z 0.000. The task name is 'FANUC Oi-T Control Panel' and the date is 08.10.2024.

# Выбор инструмента

The screenshot displays the FANUC 0i-T CNC simulator interface. The main window is titled "wanSoft CNC" and shows a 3D model of a workpiece being machined. The tool selection dialog box is open, titled "Изменить инструмент" (Change Tool). The dialog is divided into several sections:

- Поз. (Position):** A text box containing the number "1".
- Проходной упорный правый (Through-hole right-hand tool):** A row of 12 tool icons. The first icon is highlighted with a red border, indicating it is the selected tool.
- Параметры (Parameters):** A section on the right with input fields for:
  - Длина (Length): 160
  - Диаметр (Diameter): 0
  - Высота (Height): 30 (mm)
  - об/мин (RPM): 0
  - Подача (Feed): 0
- Типы пластин (Plate types):** A row of 10 icons representing different plate types: SNMG, CNMG, CNMG, DNMG, VNMG, RNMG, TNMG, and WNMG. The first icon (90° SNMG) is highlighted with a blue border.
- Параметры (Parameters):** A section on the right with input fields for:
  - Длина (Length): 12
  - Толщина (Thickness): 3
  - Радиус (Radius): 0.2 (mm)
  - Материал (Material): High-speed steel

At the bottom of the dialog, there are "Ок" (OK) and "Отмена" (Cancel) buttons. The background shows the CNC control panel with various buttons and a digital readout (DRO) system. The status bar at the bottom of the simulator displays the following information: "Размер(mm): Длина 200.000 Радиус REL:X 0.000, Z 0.000 ABS:X 0.000, Z 0.000 T:1 FANUC 0i-T Control Panel". The Windows taskbar at the bottom shows the search bar and several application icons.

# Привязка инструмента

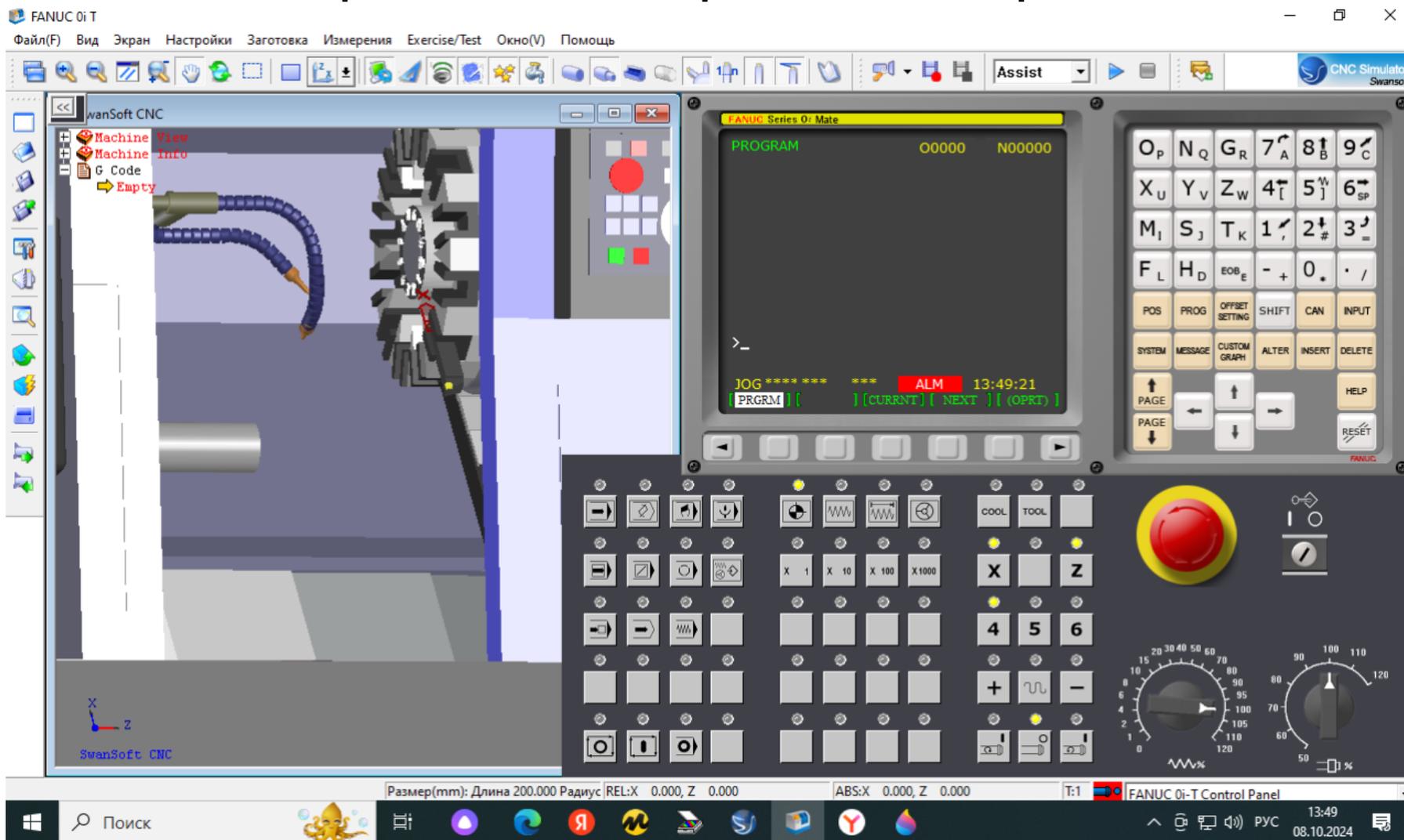
The image displays the FANUC Oi-T CNC simulator interface. The main window is titled "wanSoft CNC" and shows a 2D graphical representation of a workpiece and tool. The workpiece is a rectangular block with a width of 200.000 mm and a height of 95.000 mm. The tool is positioned at the top right corner of the workpiece. The tool tip is at the intersection of the workpiece's top and right edges. The tool's position is defined by its X and Z coordinates. The X-axis is horizontal, and the Z-axis is vertical. The tool's tip is at X = 545.000 and Z = 95.000. The workpiece's right edge is at X = 345.000. The distance between the tool tip and the workpiece's right edge is 200.000 mm. The tool's tip is at the intersection of the workpiece's top and right edges. The tool's tip is at X = 545.000 and Z = 95.000. The workpiece's right edge is at X = 345.000. The distance between the tool tip and the workpiece's right edge is 200.000 mm.

The interface includes a menu bar with options: Файл(F), Вид, Экран, Настройки, Заготовка, Измерения, Exercise/Test, Окно(V), and Помощь. A toolbar contains various icons for file operations and simulation control. The main display area is divided into several sections:

- Machine View:** Shows the graphical representation of the workpiece and tool. The workpiece is a rectangular block with a width of 200.000 mm and a height of 95.000 mm. The tool is positioned at the top right corner of the workpiece. The tool tip is at the intersection of the workpiece's top and right edges. The tool's position is defined by its X and Z coordinates. The X-axis is horizontal, and the Z-axis is vertical. The tool's tip is at X = 545.000 and Z = 95.000. The workpiece's right edge is at X = 345.000. The distance between the tool tip and the workpiece's right edge is 200.000 mm.
- Machine Info:** Shows the current machine status, including "Machine View", "Machine Info", and "G Code".
- G Code:** Shows the current G code program, which is currently empty.
- FANUC Series Oi-Mate:** Displays the current program name "PROGRAM", program number "O0000", and workpiece number "N00000".
- Control Panel:** A virtual representation of the physical CNC control panel, featuring a numeric keypad, function keys (POS, PROG, OFFSET SETTING, SHIFT, CAN, INPUT, SYSTEM, MESSAGE, CUSTOM GRAPH, ALTER, INSERT, DELETE), and a large red emergency stop button.

The status bar at the bottom provides real-time data: "Размер(mm): Длина 200.000 Радиус REL:X 0.000, Z 0.000 | ABS:X 0.000, Z 0.000 | T:1 | FANUC Oi-T Control Panel". The system tray shows the Windows taskbar with the search icon and the date "13:51 08.10.2024".

# Установка инструмента в револьверный барабан



# Написание управляющей программы

The image displays the FANUC Oi-T CNC simulator interface. The main window is titled "FANUC Series Oi Mate" and shows a 3D model of a lathe with a tool cutting a part. The G-code editor on the left contains the following code:

```
NUC\00011.CNC
Machine View
Machine Info
G Code
00011[TOCHENDIE-G73+G70]
N010T0101
N20M03S800
N30G00X70Z5
N40G73U20R10
N50G73P60Q120U1F200
N60G01X0Z0
N70#100=40
N80#101=20*SQRT[1-#100*#100/1600]
N90#100=#100-1
N100G01X[2*#101]Z[#100-40]
N110IF[#100GE-20]G0T080
N120G01Z-100
N130G70P60Q120
N140M30
N150
N110
```

The G-code editor on the right shows the following code:

```
FANUC Series Oi Mate
PROGRAM O0011 N00000
00011 [TOCHENDIE-G73+G70] ;
N010 T0101 ;
N20 M03 S800 ;
N30 G00 X70 Z5 ;
N40 G73 U20 R10 ;
N50 G73 P60 Q120 U1 F200 ;
N60 G01 X0 Z0 ;
N70 #100 =40 ;
N80 #101 =20*SQRT [1-#100*#100/1600]
>_
EDIT***** ** ALM 14:05:57
(BG-EDT)[[O.SRH]][[SRH↓]][[SRH↑]][REWIND]
```

The control panel on the right includes a numeric keypad with function keys (OP, NQ, GR, 7A, 8B, 9C, XU, YV, ZW, 4[, 5], 6SP, MI, SJ, TK, 1/, 2#, 3=, FL, HD, EOB, -, +, 0, ., /), a directional keypad, and a large red emergency stop button. The status bar at the bottom shows the current dimensions: "Размер(mm): Длина 200.000 Радиус REL:X 0.000, Z 0.000" and "ABS:X 0.000, Z 0.000". The system tray at the bottom right shows the time "14:05" and date "08.10.2024".

# Расчёт рабочего смещения и запись в таблицу

The screenshot displays the FANUC Oi-T CNC simulator interface. The main window shows a 3D model of a lathe with a tool cutting a part. The G-code editor on the left contains the following code:

```
NUC\O0011.CNC
Machine View
Machine Info
G Code
O0011[ТОЧЕМОДZ-073+070]
N010T0101
N20M03S800
N30G00X70Z5
N40G73U20R10
N50G73P60Q120U1F200
N60G01X0Z0
N70#100=40
N80#101=20*SQRT(1-#100*#100/1600)
N90#100=#100-1
N100G01X[2*#101]Z[#100-40]
N110IF[#100GE-20]GOT080
N120G01Z-100
N130G70P60Q120
N140M30
N150
N110
```

The control panel displays the following table:

FANUC Series Oi Mate		O0011		N00000	
NO.	X	Z	R	T	
G 001	-269.998	-345.000	0.000	3	
G 002	-270.000	-345.000	0.000	3	
G 003	-270.000	-350.000	0.000	3	
G 004	-490.000	-348.000	0.000	3	
G 005	-270.000	-351.501	0.000	3	
G 006	-490.000	-210.000	0.000	3	
G 007	-490.000	-210.000	0.000	3	
G 008	-512.000	-210.000	0.000	3	

Below the table, the control panel shows the actual position (relative) with U=0.000 and W=0.000. The status bar at the bottom indicates the current dimensions: REL:X 0.000, Z 0.000 and ABS:X 0.000, Z 0.000. The system clock shows 14:06:57 on 08.10.2024.

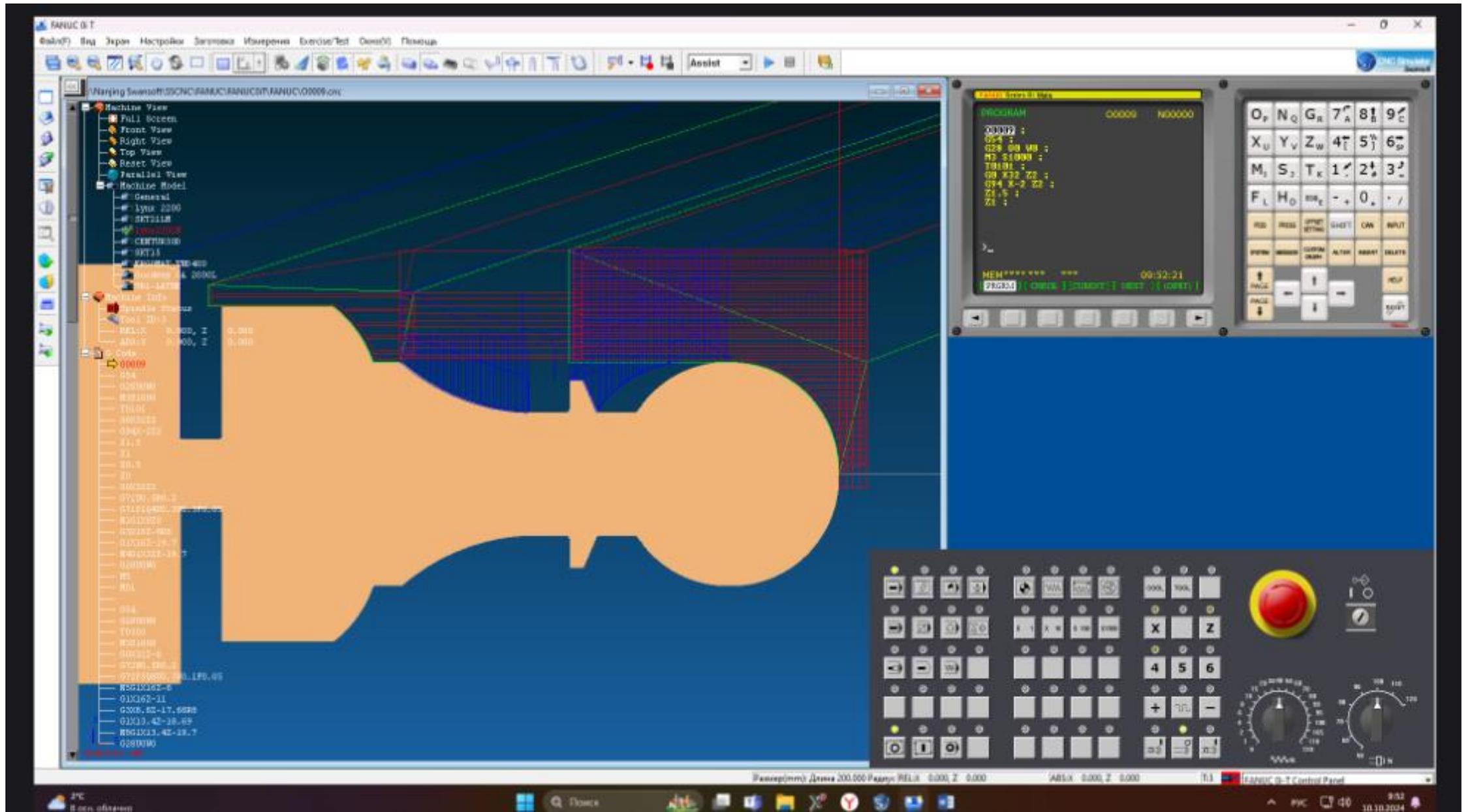
# Построение траекторий движения инструментов

The image displays the FANUC Oi-T CNC simulator interface, which is used for simulating the movement of tools in a CNC machine. The interface is divided into several main sections:

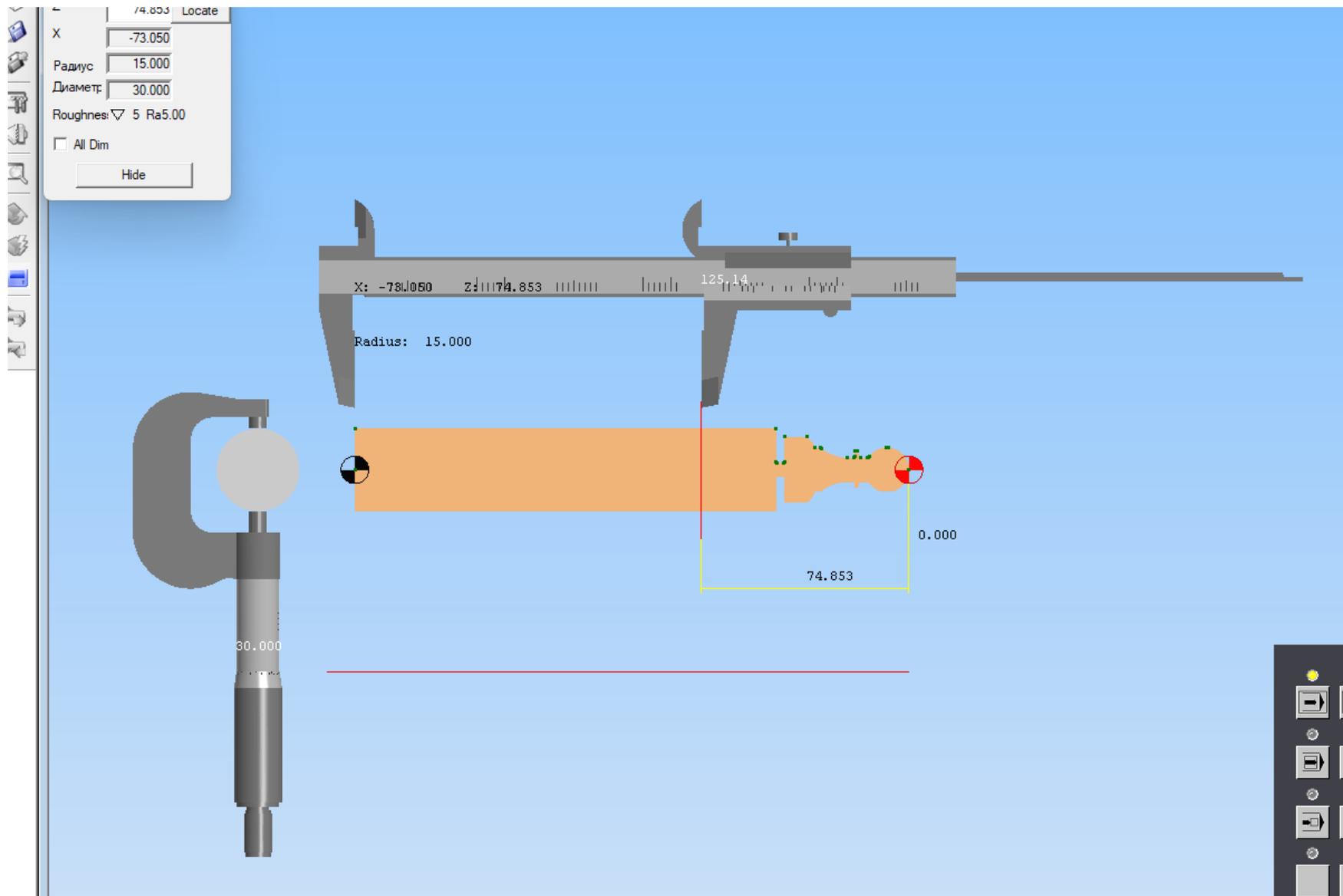
- Machine View (Left):** A 3D model of a lathe machine. The tool paths are shown as colored lines (red, green, blue) originating from the tool tip and moving along the workpiece. The workpiece is shown in a semi-transparent orange color. The tool is shown in a semi-transparent blue color. The machine model includes components like the spindle, tool holder, and tool.
- G Code Editor (Bottom Left):** A list of G-code commands for the program. The first part of the code is highlighted in orange, and the second part is highlighted in blue. The code includes:

```
00009 ;
G54 ;
G28 U0 W0 ;
M3 S1000 ;
T0101 ;
G0 X32 Z2 ;
G94 X-Z Z0 ;
Z-0.5 ;
Z-1 ;
Z-1.5 ;
Z-2 ;
G0 X32 Z2 ;
G71 U0.5 R0.2 ;
G71 P1 Q4 U0.3 W0.3 F0.05 ;
M16 X0 Z0 ;
G3 X16 Z-8 R8 ;
G1 X16 Z-19.7 ;
M40 X32 Z-19.7 ;
G28 U0 W0 ;
M5 ;
M01 ;
G54 ;
G28 U0 W0 ;
T0303 ;
M3 S1000 ;
G0 X32 Z-8 ;
G72 P5 Q8 U0.3 W0.1 F0.05 ;
M5 G1 X16 Z-8 ;
G3 X8.8 Z-17.68 R8 ;
G1 X13.4 Z-18.69 ;
M8 G1 X13.4 Z-19.7 ;
G28 U0 W0 ;
```
- Machine Info (Middle Left):** A section providing details about the machine and tool. It includes:
  - Spindle Status
  - Tool ID: 2
  - REL: X -240.000, Z -337.167
  - ABS: X 30.000, Z 0.000
- Program Editor (Top Right):** A window showing the current program being edited. It includes a title bar "FANUC Series Oi Mate", a "PROGRAM" label, and the program number "O0009 N00000". The code is displayed in a monospaced font. At the bottom, there is a status bar with "EDIT\*\*\*\*\*" and "ALM 09:10:25".
- Control Panel (Right):** A virtual control panel with various buttons and a keypad. The keypad includes letters (O, P, N, Q, G, R, 7, A, 8, B, 9, C), numbers (4, 5, 6, 1, 2, 3), and function keys (POS, PROG, OFFSET SETTING, SHIFT, CAN, INPUT, SYSTEM, MESSAGE, CUSTOM GRAPH, ALTER, INSERT, DELETE, HELP, RESET). There is also a red emergency stop button and a dial.
- Bottom Status Bar:** A bar at the very bottom of the window displaying the current dimensions and coordinates: "Размер(мм): Длина 200.000 Радиус REL:X -240.000, Z -337.167 ABS:X 30.000, Z 0.000 T:2 FANUC Oi-T Control Panel".

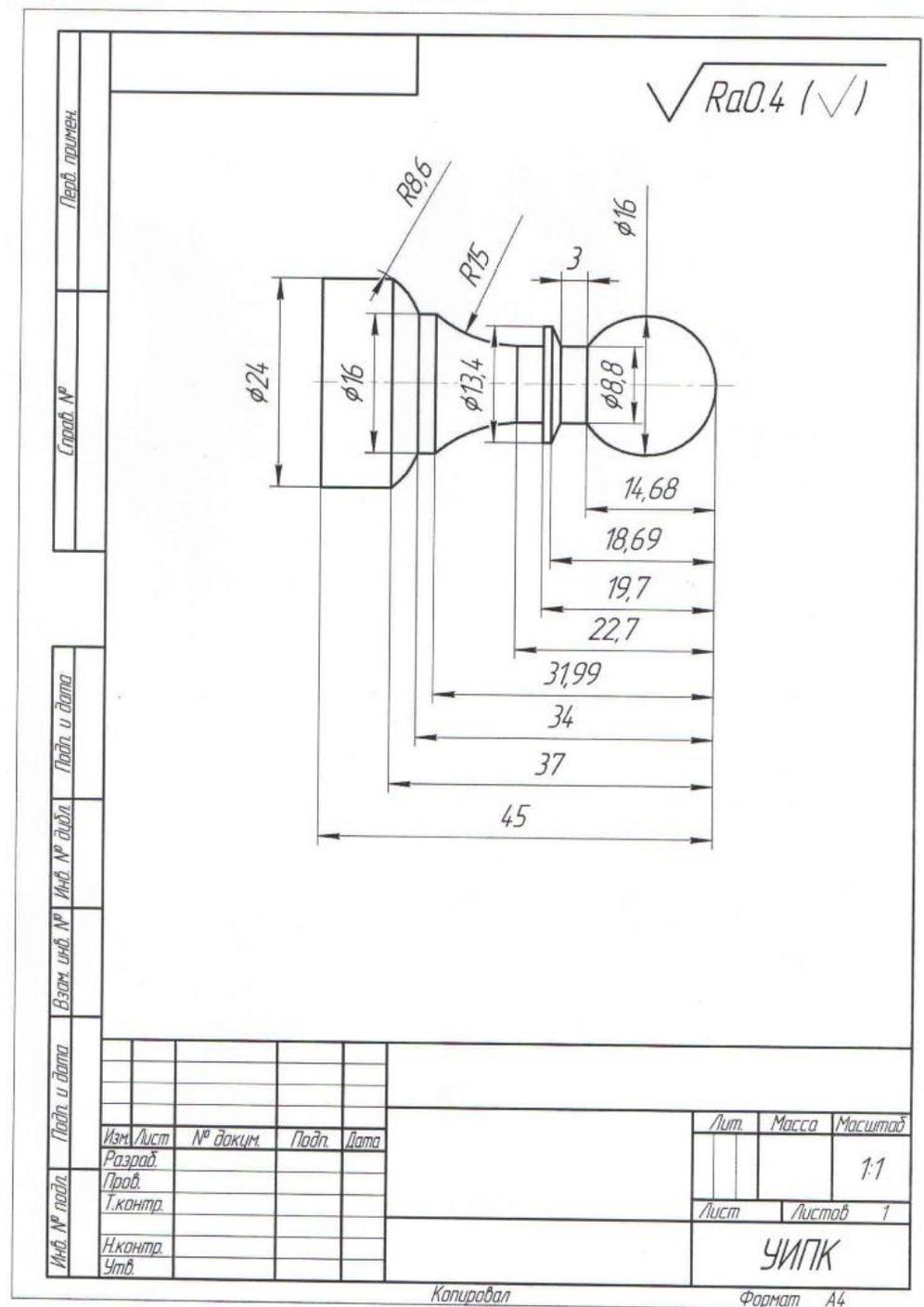
# Моделирование процесса обработки детали



# Измерение полученных размеров



# Чертёж детали



# Программа обработки детали

O0009(пешка)

G54  
G28U0W0  
M3S1000  
T0101  
G0X32Z2  
G94X-2Z2  
Z1.5  
Z1  
Z0.5  
Z0  
G0X32Z2  
G71U0.5R0.2  
G71P1Q4U0.3W0.3F0.05  
N1G1X0Z0  
G3X16Z-8R8  
G1X16Z-19.7  
N4G1X32Z-19.7  
G28U0W0  
M5  
M01

G54  
G28U0W0  
T0303  
M3S1000  
G0X32Z-8  
G72W0.5R0.2  
G72P5Q8U0.3W0.1F0.05  
N5G1X16Z-8  
G1X16Z-11  
G3X8.8Z-17.68R8  
G1X13.4Z-18.69  
N8G1X13.4Z-19.7  
G28U0W0  
M5  
M01

G54  
G28U0W0  
T0202  
M3S1000  
G0X16Z2  
G70P1Q4F0.05S2000  
G28U0W0  
M5  
M01

G54  
G28U0W0  
T0303  
M3S1000  
G0X32Z-11

G70P5Q8F0.05S2000  
G28U0W0  
M5  
M01

G54  
G28U0W0  
T0101  
M3S1000  
G0X32Z-18.7  
G90X26Z-31.99  
X25  
X24  
X23  
X22  
X21  
X20  
X19  
X18  
X17  
X16.5  
G28U0W0  
M5  
M01

G54  
G28U0W0  
T0303  
M3S1000  
G0X20Z-21.7  
G72W0.5R0.2  
G72P10Q13U0.3W0.1F0.05  
N10G1X13.4Z-22.7  
G1X8.8Z-22.7  
G2X16Z-31.99R15  
N13G1X26Z-31.99  
G0X18Z-20.7  
G1X13.4F0.05  
G0X18  
G28U0W0  
M5  
M01

G54  
G28U0W0  
T0101  
M3S1000  
G0X32Z-30.99  
G71U1R0.2  
G71P14Q18U0.3W0.3F0.05

N14G1X16Z-31.99  
G1X16Z-34  
G3X24Z-37R8.6  
G1X24Z-46  
N18G1X27Z-46  
G28U0W0  
M5  
M01

G54  
G28U0W0  
T0303  
M3S1000  
G0X18Z-22.7  
G70P10Q13F0.05S2000  
G28U0W0  
M5  
M01

G54  
G28U0W0  
T0202  
M3S1000  
G0X26Z-30.99  
G70P14Q18F0.025S2000  
G28U0W0  
M5  
M01

G54  
G28U0W0  
T0303  
M3S1000  
G0X32Z-48  
G1X20F0.05  
G1X23  
G1X15  
G1X18  
G1X10  
G1X13  
G1X5  
G1X32Z-48  
G28U0W0  
M5  
M30

%