

# Instruction manual of lite version of the program "Multilingual local instrumental system of goal achievement optimization, version 2.2" (LVP MLIS GAO 2.2)

## Installing LVP MLIS GAO 2.2

1. Copy to a separate folder of your computer disk space a set of files of LVP MLIS GAO 2.2.
2. Check the composition of this set, which should include the following files:
  - boot file **Lite\_MLIS\_GAO.exe** of this program;
  - boot file **GLS.exe** of utility program of version 1.0 under the name "**Генератор языковых оболочек (ГЯО 1.0)** (Generator of language shells (GLS 1.0))", which allows to create language shells for LVP MLIS GAO 2.2 interface;
  - contents of the folder **Data** — data files (with extension dat) for several solved demonstration tasks, near to which will be placed data files for tasks to be solved by the user;

### *Note*

The installation set of LVP MLIS GAO 2.2 includes nine solved demonstration tasks, not available for removal, which are presented in two options: *Russian* ("DEMR01", "DEMR02", "DEMR03", "DEMR04", "DEMR05", "DEMR06", "DEMR07", "MR04.1", "MR04.2") and *English* ("DEME01", "DEME02", "DEME03", "DEME04", "DEME05", "DEME06", "DEME07", "ME04.1", "ME04.2"). Input and output data of these tasks you can look through at the screen, as well as bring out to Excel-files or print.

- contents of the folder **Excel documents** (it includes two subfolders: **rus** and **eng**) — files of table format Excel (with extension xls), in which can be stored input data of any tasks, as well as output data of solved tasks;

### *Note*

The installation set of LVP MLIS GAO 2.2 includes Excel-files in Russian and English with the input data of nine demonstration tasks. These files, as well as any others with input data of tasks you can not only view or edit in Microsoft Excel, but import to LVP MLIS when creating new tasks.

- contents of the folder **Shells** — files of language shells for the current program interface;

### *Note*

The installation set of LVP MLIS GAO 2.2 includes two files of shells for Russian and English languages: **Shell (GAO 2.2).rus** и **Shell (GAO 2.2).eng**.

- contents of the folder **Solving** — in this initially empty folder temporarily are placed data files for the tasks which are in the stage of solving;
  - contents of the folder **System**:
    - **info** — a text file containing three main parameters of your computer: processor type, clock rate and the volume of operative memory;
    - **Protocol.opt** — file of a protocol of tasks, being solved by the user, which holds general information about all existing tasks and their current state;
    - **Languages.txt** — a text file containing a list of possible language shells for the interface of this program;
    - **Programs.txt** — a text file containing names of those programs (including this one), for which may be created language shells by using the utility program ГЯО 1.0 (GLS 1.0);
  - contents of the subfolder **User documents**:
    - files of three Russian-language documents in the subfolder **rus**:
      - **Инструкция по эксплуатации ГЯО 1.0.pdf**;
      - **Инструкция по эксплуатации ОВП МЛИС ОДЦ 2.2.pdf**;
      - **Технические характеристики МЛИС-МСИС ОДЦ 2.2.pdf**;
    - files of three English-language documents in the subfolder **eng**:
      - **Instruction manual of GLS 1.0.pdf**;
      - **Instruction manual of LVP MLIS GAO 2.2.pdf** — file of this manual;
      - **Technical characteristics of MLIS-MNIS GAO 2.2.pdf**.
3. For ease of launching the program LVP MLIS GAO 2.2, create a shortcut for its file **Lite\_MLIS\_GAO.exe** and place it on the desktop of your computer.

## **Run the program in operation**

1. Click on the boot file **Lite\_MLIS\_GAO.exe** of the program or on its label. At that happens the following:
  - in the absence in the folder **Shells** of any language shells files appears on the screen a warning message that the work in the program LVP MLIS GAO 2.2 for this reason is impossible and it emergency closes;
  - in the presence in this folder of only one language shell file is launched the program, which interface is presented by the language of this shell;

- in the presence there of two or more files of language shells happens transition to the next instruction item.
2. On the screen opens the window of the program LVP MLIS GAO 2.2 without any records of its interface, and in its center appears a small dialog under the name **Selection of program interface language**. From the drop-down list of this dialog select desired language of program interface and click the button **OK**. At that, the dialog closes and in the program window, which becomes available to work, appear necessary records in language that you just selected. In the same language will be output any text entries in all windows of the program, as well as all information provided in it.

## Creating a new task with unique parameters

If in a new task of goal achievement optimization its parameters will differ from the similar parameters of any existing task, do the following:

1. Choose the command **Input⇒Input of a new task**, opening the dialog **Input of task data (step 1 of 8)**, where do the following:
  - enter to the first field a six-digit code of a new task (it may include Latin characters and digits);
  - enter to the second field the name of this task.
2. Click the button **Forth** in the current dialog, going to the dialog **Input of task data (step 2 of 8)**, where set the following parameters:
  - minimized parameter: cost/time of executing the network graph (two upper switches);
  - total number of chains of operations in the graph (first field);
  - number of nested chains of operations in the graph (second field);
  - units of measurement for cost and time of execution of operations (two drop-down lists);
  - when choosing the mode to minimize the *cost* of executing the graph (left switch of the first group):
    - mode of presence/absence temporarily unavailable resources (TUR) (two switches of the second group);
    - when choosing the mode of presence TUR (left switch of the second group):
      - number of categories of TUR (third field);
    - when choosing the mode of absence TUR (right switch of the second group):
      - mode of decomposition of the network graph (two switches of the third group);
      - mode of numbering nested network subgraphs (NNSGs) (two switches

- of the fourth group);
- first parameter of the graph decomposition: available number of selected NNSGs (second field from bottom);
- second parameter of the graph decomposition: maximum number of quantization steps of time of executing NNSG (first field from bottom).
- when choosing the mode to minimize the *time* of executing the graph (right top switch):
  - mode of the graph decomposition (two switches of the third group);
  - mode of numbering NNSGs (two switches of the fourth group);
  - two parameters of the graph decomposition.

**Note**

The further order of setting parameters of the task depends on the previously set parameters. There are two possible options for further actions on setting parameters, each of which is realized when fulfills the corresponding conditions (see below).

**Condition of *absence* of temporarily unavailable resources**

3. Click the button **Forth** in the current dialog, going to the dialog **Input of task data (step 3 of 8)**, where set the following parameters for chains of operations of the network graphs:
  - name of the chain (second field of the table);
  - number of operations in the chain (third field of the table);
  - in the presence in the graph of nested chains of operations:
    - when choosing the mode of the graph decomposition and the manual mode of numbering NNSGs:
      - number of a NNSG, to which the chain relates (fourth field of the table);
      - coordinates of that operation of the other chain, from the start of which the current chain exits (fifth and sixth fields of the table);
      - coordinates of that operation of the other chain, to the end of which the current chain enters (seventh and eighth fields of the table);
      - mode of automatic conversion of usual operations of the graph into crucial ones (two right switches);
  - place in the initial chain (its start or end), where will be deleted excessive operations or added new (two left switches).
4. Click the button **Forth** in the current dialog, going to the dialog **Input of task data (step 4 of 8)**, in which for each chain of the graph (drop-down list), set the following parameters of its operations:

- name of the operation (second field of the table);
  - number of options of its realization (third field of the table).
5. Click the button **Forth** in the current dialog, going to the dialog **Input of task data (step 5 of 8)**, in which for each chain of the graph (first drop-down list) and its each operation (second such list) set the following parameters of the last:
    - essence of option of realizing operation (second field of the table);
    - time of its execution (third field of the table);
    - cost of its execution (fourth field of the table).
  6. Click the button **Forth** in the current dialog, going to the dialog **Input of task data (step 6 of 8)**. In it you can see all parameters entered in previous dialogs.
  7. Click the button **Forth** in the current dialog, going to the dialog **Input of task data (step 7 of 8)**, where set the following parameters:
    - type of rounding discretizable parameters: on minimum, on middle or on maximum (three switches);
    - duration of increment, which is a step of rounding the time (cost) parameters while minimizing the cost (time) of executing the network graph (first field);
    - security scaling factor of analog parameters, which provides their protection from possible unauthorized access to them by third parties in case of performing calculations for some tasks on another computer with the purpose of accelerating their processing (second field).
  8. Click the button **Forth** in the current dialog, going to the dialog **Input of task data (step 8 of 8)**, which has two options of presenting on the screen:
    - if as a minimized parameter you choose the *cost* of executing an arbitrary network graph or the *time* of executing such a graph, the resultant part of which (after decomposition) will consist of a single chain of operations, the scrolling list will appear in the dialog, in which set the required values of a threshold of restricting time (cost) of executing the graph while minimizing the cost (time) of its execution. The number of such values should not exceed ten;

### **Note**

When selecting thresholds of restriction of time or cost of executing the graph refer to the help information displayed on the screen, representing the minimum and maximum possible values of time and cost of its execution.

- if as a minimized parameter you choose the *time* of executing the graph, the resultant part of which will consist of two or more chains of operations, the three fields will appear in the dialog, in which set the following parameters:
  - threshold of restricting the cost of executing the graph (first field);
  - allowable number of iterations of second level (second field);

- factor of reducing the number of iterations of second level due to the multiplicity of increasing the value of changing the time threshold (third field).

### **Note**

Minimum relative value of changing the time threshold is 1% from the difference between maximum and minimum possible values of time of executing the network graph.

9. Click the button **Forth** in the current dialog, going to the dialog **Input of task data**. Look through in it the main input data of the task and if you are not satisfied by them, then using the button **Back** go to the desired previous dialog and make there necessary correction of the tasks input data. Otherwise, do one of two things:
  - at selected by default the switch **later** (it is located at the bottom right) click the button **Ready**, causing the program to form two files in the folder **Data**: a common file of the task (**gao\_<six-digit task cipher>.dat**) and its input file (**gao\_<task cipher >\_in.dat**);
  - select the switch **at once** (bottom left) and click the button **Ready**, causing this task to be solved at once without using stipulated for this aim the next commands: **Control**⇒**Work with a task protocol** и **Solving**⇒**Execution of optimization**.

## **Condition of presence of temporarily unavailable resources**

### **Note**

In the presence of TUR the decomposition of the network graph is impossible.

3. Click the button **Forth** in the current dialog, going to the dialog **Input of task data (step 2a of 8)**, in which set the number of intervals of accessibility of resources for all categories of TUR.
4. Click the button **Forth** in the current dialog, going to the dialog **Input of task data (step 2b of 8)**, in which set the following two parameters for each category of TUR and related to it the interval of availability of resources:
  - moment of the start of an availability interval (third field of the table);
  - moment of the end of an availability interval (fourth field of the table).
5. Click the button **Forth** in the current dialog, going to the dialog **Input of task data (step 3 of 8)**, where set the following parameters for chains of operations of the network graphs:
  - name of thr chain (second field of the table);
  - number of operations in the chain (third field of the table);
  - in the presence in the graph of nested chains of operations:
    - coordinates of that operation of the other chain, from the start of which the curren chain exits (fifth and sixth fields of the table);
    - coordinates of that operation of the other chain, to the end of which the curren chain enters (seventh and eighth fields of the table);

- mode of automatic conversion of usual operations of the graph into crucial ones (two right switches);
  - place in the initial chain (its start or end), where will be deleted excessive operations or added new (two left switches).
6. Click the button **Forth** in the current dialog, going to the dialog **Input of task data (step 4 of 8)**, in which for each chain of the graph (drop-down list), set the following parameters of its operations:
    - name of the operation (second field of the table);
    - number of options of its realization (third field of the table).
  7. Click the button **Forth** in the current dialog, going to the dialog **Input of task data (step 5 of 8)**, in which for each chain of the graph (first drop-down list) and its each operation (second such list) set the following parameters of the last:
    - essence of option of realizing operation (second field of the table);
    - category of used resource (third field of the table);
    - a possible sign of suspension of executing the operation (\*) (fourth field of the table);
    - net time of its execution (fifth field of the table);
    - cost of its execution (six field of the table).

**Note**

The actual time of executing an operation may be larger than the net such time in case when is used a temporarily unavailable resource.

8. Click the button **Forth** in the current dialog, going to the dialog **Input of task data (step 6 of 8)**. In it you can see all parameters entered in previous dialogs.
9. Click the button **Forth** in the current dialog, going to the dialog **Input of task data (step 7 of 8)**, where set the following parameters:
  - type of rounding discretizable parameters: on minimum, on middle or on maximum (three switches);
  - duration of increment, which is a step of rounding the time (cost) parameters while minimizing the cost (time) of executing the network graph (first field);
  - security scaling factor of analog parameters, which provides their protection from possible unauthorized access to them by third parties in case of performing calculations for some tasks on another computer with the purpose of accelerating their processing (second field).
10. Click the button **Forth** in the current dialog, going to the dialog **Input of task data (step 8 of 8)**, which has two options of presenting on the screen:
  - if as a minimized parameter you choose the *cost* of executing an arbitrary network graph or the *time* of executing such a graph, the resultant part of which (after decomposition) will consist of a single chain of operations, the scrolling

list will appear in the dialog, in which set the required values of a threshold of restricting time (cost) of executing the graph while minimizing the cost (time) of its execution. The number of such values should not exceed ten;

### **Note**

When selecting thresholds of restriction of time or cost of executing the graph refer to the help information displayed on the screen, representing the minimum and maximum possible values of time and cost of its execution.

- if as a minimized parameter you choose the *time* of executing the graph, the resultant part of which will consist of two or more chains of operations, the three fields will appear in the dialog, in which set the following parameters:
  - threshold of restricting the cost of executing the graph (first field);
  - allowable number of iterations of second level (second field);
  - factor of reducing the number of iterations of second level due to the multiplicity of increasing the value of changing the time threshold (third field).

### **Note**

Minimum relative value of changing the time threshold is 1% from the difference between maximum and minimum possible values of time of executing the network graph.

11. Click the button **Forth** in the current dialog, going to the dialog **Input of task data**. Look through in it the main input data of the task and if you are not satisfied by them, then using the button **Back** go to the desired previous dialog and make there necessary correction of the tasks input data. Otherwise, do one of two things:

- at selected by default the switch **later** (it is located at the bottom right) click the button **Ready**, causing the program to form two files in the folder **Data**: a common file of the task (**gao\_<six-digit task cipher>.dat**) and its input file (**gao\_<task cipher >\_in.dat**);
- select the switch **at once** (bottom left) and click the button **Ready**, causing this task to be solved at once without using stipulated for this aim the next commands: **Control**⇒**Work with a task protocol** и **Solving**⇒**Execution of optimization**.

## **Creating a new task with repetitive parameters**

If a new task has the same parameters of operations as some existing task, do the following:

1. Choose the command **Input**⇒**Input of a new task by data import**, opening the dialog **Input of task data (step 1 of 8)**, where do the following:
  - select format of a file to be imported which contains input data of another task: own format of the program (left switch **DAT**) or standard format Excel (right switch **XLS**);

### *Note*

Mode of import into a new task of input data of another task, been stored in Excel-file, was introduced due to the fact that the program has a mode of export input data of existing tasks into files of Excel type (command **Export of data to Excel-table** of menu **Output**).

- when selecting **DAT** do the following:
    - enter to the first field a six-digit code of a new task;
    - enter to the second field a name of this task;
    - in the drop-down list select such existing task, which input data should be copied to the current task;
    - click the button **Import**;
  - when selecting **XLS** do the following:
    - click the button **Import of Excel-file**;
    - in the opened dialog **Open** select on the disk required file (with the extension xls), and click the button of the same name;
    - if two fields of the dialog are left empty, enter to the first of them a six-digit code number of a new task, and to the second — a task name.
2. Moving with the button **Forth** from the current dialog to a next one, look through in all twelve dialogs the input data of a current task and make necessary changes in them (see above Sec. "Creating a new task with unique parameters").
3. Click the button **Ready** in the last dialog. At that, in the folder **Data** are created two files of the task: general and input.

## Correction of task input data

This operation can be performed in two ways:

- during the operation to create a new task (see above).
- by using the command **Input⇨Correction of input data of unsolved task**, that is available for use to such unsolved tasks, which input files have not been copied to the folder **Solving** for their solution.

## Uploading a file with input data of a new task

After creating a new task, you need to copy its input file (with input data of the task) to the folder **Solving** for its subsequent solution (see below). This operation is performed in the following order:

### *Note*

After completing the operation in question concerning to some unsolved task you can not correct its input data.

1. Choose the command **Control⇒Work with a task protocol**, opening the dialog **Protocol of tasks**.
2. Select in the dialog upper list the required task, for which the operation in question was not fulfilled (this is indicated by the record "A stage of data input" in line "Task state" of the protocol table).
3. Click the button **Upload the file of task input data**, which in this case becomes unlocked. At that happens the following:
  - in the folder **Solving** appears a duplicate of the input file of current task;
  - in line "Task state" of the protocol table appears record "Waiting for solution";
  - the button **Upload the file of task input data** becomes locked.

## Solving tasks

Operation of solving tasks, which input files are placed in the folder **Solving**, is performed in the following order:

1. Choose the command **Solving⇒Execution of optimization**, opening the dialog **Optimization module of MLIS GAO 2.2**.
2. Set the desired mode of processing: *batch* (for solving all group of tasks) or *individual* (for solving only one task), and then click the button **Next**.
3. When working in batch mode, do the following:
  - if necessary, adjust specified parameters of optimization, and then click the button **Next**;
  - click the button **START** at the bottom, resulting in a process of successive solving the tasks of this group, when a name of this button changes to **WORK**;
  - after this button again be called **START**, which indicates the completion of solving the entire group of tasks, close the dialog **Optimization module of MLIS GAO 2.2** by clicking the button **EXIT** (bottom right).
4. When working in individual mode, do the following:
  - type in the dialog field a six-digit cipher code of a solvable task and click the button **Next**;
  - if necessary, adjust the parameters of optimization scheme, and then click the button **Next**;
  - click the button **START** at the bottom, resulting in a process of solving selected task, when a name of this button changes to **WORK**;
  - after this button again be called **START**, which indicates the completion of solving the current task, close the dialog **Optimization module of MLIS GAO 2.2** (button **EXIT**).

## Connecting a file with task solving results

After performing the operation of solving tasks you should transfer files with results of their solution (**gao\_<task cipher>\_out.dat**) from the folder **Solving** to the folder **Data**. This operation is performed in the following order:

### *Note*

After performing this operation concerning some solved task it is impossible its repeated processing. That may be required, in particular, in case of absence of its successful solution due to wrong choice of values of the optimization schemes parameters.

1. Choose the command **Control⇒Work with a task protocol**, opening the dialog **Protocol of tasks**.
2. Select in the upper dialog list the required task, which input file was copied to the folder **Solving** (this is indicated by the record "Waiting for solution" in line "Task state" of the protocol table).
3. Click the button **Load the file of task solving results**, which in this case becomes unlocked. At that happens the following:
  - input file of the current task is removed from the folder **Solving**, and its output file is moved from this folder to the folder **Data**;
  - in line "Task state" of the protocol table appears record "Task is solved";
  - the button **Load the file of task solving results** becomes locked.

## Working with a tasks protocol

A protocol of tasks contains general information about existing tasks of goal achievement optimization, being solved by LVP MLIS GAO 2.2 (these data are stored in the file **Protocol.opt** placed in the folder **System**). On the screen displays in tabular form such part of the protocol, which refers to a user-selected task. It contains the following formation:

- cipher and name of this task;
- current state of the task, which can be one of three: " A stage of data input", "Waiting for solution" or "Task is solved";
- dates and times of occurrence for the four different event.

Transition to the mode of work with a tasks protocol is performed by the command **Control⇒Work with a task protocol**, which opens the dialog **Protocol of tasks**. In this window, the following operations can be performed:

- viewing general information about the existing tasks;
- upload the input file a new task, that contains its input data (see above);
- connecting the output file of the task containing the results of its solution (see above);
- removal of those tasks that are no longer necessary for the user (button **Delete the task**).

## Output of task input data

Input data for any existing task of goal achievement optimization may be brought out to screen, Excel-file and print. This operation is performed in the following order:

1. Choose the command **Output⇒Viewing input data of any task**.
2. In the opened dialog **List of all tasks** select the desired task and click the button **OK**. At that, the current dialog is closed and opens the window **Viewing input data of the task "<task name>"** with tabular input data of the task chosen by you, which can be looked through.
3. To bring out these data to a new Excel document, choose the command **Export of data to Excel-table** of menu **Output**, to print them — the command **Printing of data** of the same menu.

## Output of task solving results

Output data for any solved task of goal achievement optimization may be brought out to screen, Excel-file and print. This operation is performed in the following order:

1. Choose the command **Output⇒Viewing output data of solved task**.
2. In the opened dialog **List of solved tasks** select the required task and click the button **OK**. At that, the current dialog is closed and opens the window **Viewing solution result of the task "<task name>"** with tabular output data of the task. You can look through them here for any specified threshold of restricting the time or the cost of the network graph execution, clicking in bottom of the the dialog on the label of its appropriate tab.
3. To bring out these data to a new Excel document, choose the command **Export of data to Excel-table** of menu **Output**, to print them — the command **Printing of data** of the same menu.

## Accompaniment of realizing the task solution result

As a result of solving by you the task for some network graph (NG) are found by numerical way the optimal options of realizing all its operations for the specified variants of the threshold of restricting the time or the cost of NG execution. In the process of practical realization of this NG for the selected variant of the threshold of restricting its execution may change for whatever reasons both the parameters of fulfilled operations, and this limitation. In this case, you need to re-solve the optimization tasks with regard to the original NG, setting at that the actual parameters of its already fulfilled operations and, if necessary, the new values of the threshold of restricting NG execution. This procedure is called here by the accompaniment of realizing the task solution result. The order of its fulfillment is given below.

1. Display the result of solving the demanded for you task for the selected threshold of restricting the time or the cost of NS execution (see above. prev. Sec.). This result will

guide you in the NG practical realization, which you can output to an Excel table or to print (see the same Sec.).

2. Choose the command **Output⇒Export of data to Excel-table**. At that appears on the screen an information panel with the question of whether you will output to the Excel-table the task input data with a purpose to accompany the future realization of the NG? where you should click the button **Yes**. As a result, will be formed and opened on the screen the document Excel with such data of NG and with states of its operations realization options (OROs).
3. Go to the page "Parameters of operat. (2)" of this document, where are highlighted by color the lines with the found as a result of task solution the optimal options or executing all NG operations. For those of its operations that have already been realized or are being realized now, correct manually the data in the three rightmost fields (columns), numbered 6-8. At that you should be guided by the following rules of editing the table contents:
  - for ORO state =1 (this parameter is specified in field 8) is allowed to change the line of the table (i.e. the option of realizing the operation), as well as the contents of fields 6-8; for ORO state =2 — only the contents of fields 6-8 (since the option of realizing the operation has been selected), and for ORO state =3 — nothing can be changed (since the operation has already been completed);
  - the current state of ORO you can only increase from 1 to 3, or leave the same;
  - terms of editing the field 8 contents:
    - there may only be a digit "1", "2" or "3", or its lack;
    - if there is a digit, then it should be the only one among all options of executing this operation;
    - if for some operation of NG chain is the following:
      - there is the digit "1", it should be the same at all subsequent operations of the chain;
      - there is the digit "2", it should be "3" at its previous operations, and "1" at the following ones.
      - there is the digit "3", it should be for all of its previous operations.
4. Save the document in the file under any name.
5. Create the next task, which will be derived from the current one by importing its input data from the Excel-file you created (see above Sec. "Creating a new task with repetitive parameters").
6. Solve this task (see above), and then display the result of its solution for the required threshold of the time or the cost of restricting NG execution, that will guide you in the further practical realization of the graph.
7. If during the process of realizing NG will be a need for recalculation of its parameters, go to step 2 of this instruction.

**Note**

The set of LVP MLIS GAO 2.2 includes two solved tasks of realization accompaniment for the NG found by solving the demo-task "DEMR04" (in Russian) or "DEME04" (in English). Here they are: "MR04.1" and "MR04.2" (in Russian) or "ME04.1" and "ME04.2" (in English). The Excel files with input data of these tasks, containing examples of filling the field 8 of the table "Parameters of operat. (2)", are in the folder **Excel documents**.