

The handbook of LoadProGen

The load profiles generator of Politecnico di Milano

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1 Where to find Version 2.0

You can download the latest version of LoadProGen following this link¹.

2 What's new in Version 2.0

2.1 The input file

All the input data are saved in a Matlab file called *input_data.mat* located in the folder *input_LoadProGen*. This new file reorders into nine variables all the information necessary for the profiles generation. This Matlab file can be created in two different ways, each user can choose between the methods depending on its specific needs:

- the first method allows to insert the input data into an electronic sheet, the software will automatically reads the Excel file and it will create the matlab file *input_data.mat*;
- the second possibility is to use the graphic user interface (GUI) of the software, in this case the user will directly act on the matlab file *input_data.mat*, reading and writing it.

2.2 The sample time

In the previous version of LoadProGen, the load profile could be generated only with a sample time of a minute. This means that the daily profile you could generate had to be composed of 1440 values. In the new version you can choose the sampling time among this options: 1 second, 1 minute, 15 minute, 1 hour. The new possibilities can be usefull in two different cases: the profile with higher density of value (sample time of one second) can be necessary when evaluating rapid reaction of component of the system such as generators or storage systems; the profiles with lower density of value (15 minutes and 1 hour) could be the best options when a complicated scenario is considered and only the main trend of the profiles is needed. Obviously, a new formulation of the problem will be necessary because functioning cycle, functioning time and functioning windows should be expressed as a multiple of the sample time.

¹If the link doesn't work, you can copy and paste in your browser the following url: www.goo.gl/mSQFHP

2.3 Specific profile for some appliances

In the previous version of LoadProGen, the functioning cycle of an appliance could be only a series of instant in which the appliance was considered ON at the nominal power. It means that when you visualize the power profile of the appliance, it is always a rectangle where the nominal power is the height. That can be perfect for an appliance that works at the nominal power, such as a light, but it can not represent the real functioning cycle of other appliances, such as washing machine. In this case the appliance doesn't work at constant power, but it has a typical power profile. In LoadProGen 2.0 there is the possibility to consider a typical load profile for each appliance. This possibility is available when using a sample time of a second or sample time of a minute; that level of detail doesn't make sense when using sample times longer than a minute.

3 How to use LoadProGen

In the following paragraphs the two different possibilities to generate load profiles with LoadProGen are shown step by step.

3.1 Use LoadProGen with the GUI

1. Start Matlab
2. Move to the folder *code*
3. Write in the command window *LoadProGen* e press *Enter*. The following window should appear²:

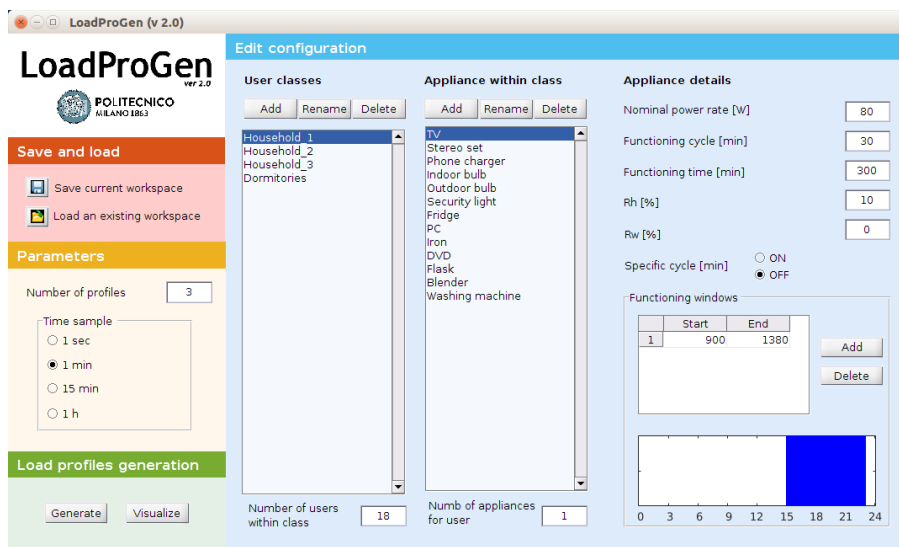


Figure 1: LoadProGen graphic user interface

²If you don't see the graphic user interface in the right way try to resize the windows, the hidden parts of the text and the hidden parts of the cells should appear.

4. Define the configuration for the load profiles generation. The configuration is composed by three sections:
 - User classes - In which the number and the name of the classes of users are specified and, for each class, the number of users should be defined.
 - Class detail - In which, for each class, you should define the number and the type of appliances used by the users within that class, and the number of devices of the considered kind used by a single user.
 - Appliance detail - In this section you have to specify for each appliance:
 - The nominal power of the appliance
 - The minimum functioning cycle for that appliance
 - The total functioning time, during a day, for the considered kind of appliance
 - The uncertainty associated with the total functioning time (R_h)
 - The uncertainty associated with the functioning windows (R_w)
 - The presence or not of a specific cycle for the considered appliance - When ON is selected, the nominal power of the appliance and the duration of its cycle cannot be changed but the shape of the power profile can be modified clicking on *Cycle*. Remember that the functioning cycle has always to be expressed in minute and it will not be considered during elaboration if a sample time longer than a minute is selected.
 - The functioning windows
5. Define the following parameters for the generation of the load profiles:
 - Number of profile to generate
 - Sample time - When you change that value, windows and functioning times are automatically converted, but a check to those value is important to preserve the meaning of the problem.
6. Press on *Generate Profiles* and wait for the generation of the profiles. Check the progress with the bar that will appear after the click.

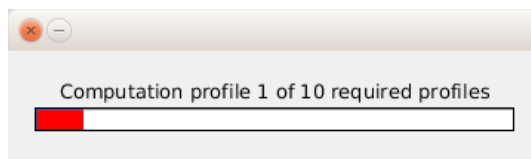


Figure 2: Progress bar

7. When the process ends, the profiles are saved in the matlab file called *daily_load_profiles.mat* and positioned in the folder *output_LoadProGen*. It contains the profiles saved in the form of a matrix composed by a number of row equal to the number of profiles generated and a number of columns that depends on the sample time (24, 96 or 1440). It is possible to visualize the generated profiles clicking on *Visualize Profiles*. The following window should appear:

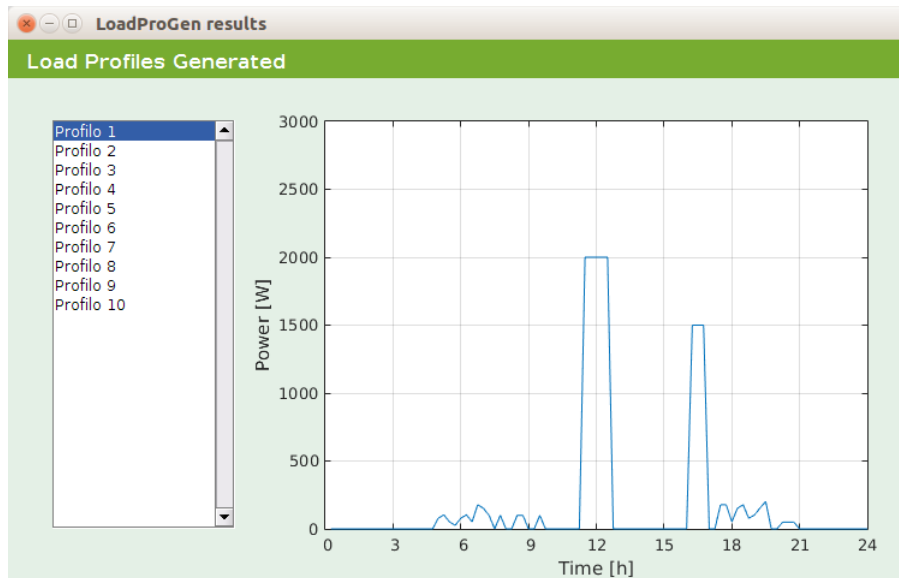


Figure 3: Visualization of the generated profiles

3.2 Use LoadProGen with the Excel input file

1. Open the Excel file named *Configuration.xlsx* that you can find in the folder named *input_LoadProGen*. The first sheet is called *Parameters* and an example is shown in Figure 4. Select that sheet and fill it, you have to specify:
 - The number of load profiles you want to generate.
 - The number of time steps, that is the number of value of a single daily profile; it can be 24 if you consider a sample time of one hour, 96 if you consider a sample time of a quarter of hour, 1440 if you consider a sample time of a minute, 86400 if you consider a sample time of a minute.
 - The number of user classes, that will be the number of sheet that Matlab has to read.
 - The maximum number of appliances, that will be the maximum number of row that Matlab has to import.
 - The maximum number of functioning windows, that will define the maximum number of columns that Matlab has to read.
 - The specific profiles of the appliance, expressed in minutes.
2. The other sheets of the the Excel file *Configuration.xlsx* are used to define the characteristics of a user class. As you can see in Figures 5 and 6, for each class you have to specify:
 - The name of the class;
 - The number of users in the class;

	A	B	C	D	E	F	G
1	Parameters for the generation						
2							
3	Number of load profiles	3					
4	Number of time step	1440					
5	Number of user classes	4					
6	Maximum number of appliance	13					
7	Maximum number of windows	2					
8							
9							
10	Power profiles of specific appliances						
11							
12	Time [min]	1	2	3	4	5	6
13	Cycle1	2000	2000	2000	2000	2000	2000
14	Cycle2	2000	2000	2000	2000	2000	2000
15							

Figure 4: The worksheet *Input_parameters*

- The name of each appliances used by the user of the considered class;
- The nominal power of the appliance;
- The number of devices of each kind used by a single user;
- The minimum functioning cycle for that appliance if it has not a specific functioning cycle or the name of the specific cycle as defined in the sheet *Input_parameters* if the appliance has a specific functioning cycle;
- The total functioning time, during a day, for the considered kind of appliance if it has not a specific functioning cycle or the number of times that the cycle is repeated in a day if the appliance has a specific functioning cycle;
- The uncertainty associated with the total functioning time (Rh);
- The uncertainty associated with the functioning windows (Rw);
- The functioning windows;

	A	B	C	D	E	F	G
1	Specific user class (j)	Number of users in class (N_j)	Type of electrical appliance (i)	Nominal appliance power rate [W] (P_i)	Number of appliances in class (n_{ij})	Functioning cycle [min] (d_i)	Functioning time [min] (h_i)
2	Family AC_3	15	Lights (normal)	3	8	10	360
3			Phone Charger	5	2	30	180
4			Radio	5	1	15	240
5			Security Light	5	2	30	720
6			AC-TV (small)	100	1	30	300
7			Fridge (small)	250	1	10	300

Figure 5: The structure of a sheet with the details of a class (columns A-G)

	H	I	J	K	L	M	N	O
1	Rh [%] [0-100]	Rw [%] [0-100]	Starting time Win 1 [min] [1-1440]	Ending time Win 1 [min] [1-1440]	Starting time Win 2 [min] [1-1440]	Ending time Win 2 [min] [1-1440]	Starting time Win 3 [min] [1-1440]	Ending time Win 3 [min] [1-1440]
2	5	10	1	120	1020	1440	0	0
3	0	0	1	540	780	900	1020	1440
4	0	0	360	540	1020	1440	0	0
5	10	10	1	420	1020	1440	0	0
6	0	0	660	900	1020	1440	0	0
7	20	0	1	1440	0	0	0	0

Figure 6: The structure of a sheet with the details of a class (columns H-O)

3. Call from the command window the script called *load_excel*, this function will read the Excel file and it will create the matlab file *Input_data_excel.mat*

4. Call from the command window the script called *LoadProGen_main* and wait for the end of the procedure.
5. At the end, the profiles will be saved in the matlab file called *daily_load_profiles.mat*, that is positioned in the folder *output_LoadProGen*. It contains the profiles saved in the form of a matrix composed by a number of row equal to the number of profiles generated and a number of columns that depends on the sample time (24, 96 or 1440).

It is a 3D matrix of dimension $N_{max_app} \times 6 + 2 \cdot N_{max_win} \times N_{uc}$ in which different rows represent different appliances and different layers represent different classes.