

TWO DIMENSIONAL OPTIC DATA FOR COMPLEX FENESTRATION SYSTEMS IN ESP-R BLACK BOX MODEL

for more information about the black box model please refers to:

- [1] Tilmann E. Kuhn, Sebastian Herkel, Francesco Frontini, Paul Strachan, Georgios Kokogiannakis, *Solar control: A general method for modelling of solar gains through complex facades in building simulation programs*, Energy and Buildings, Volume 43, Issue 1, January 2011, Pages 19-27, ISSN 0378-7788
- [2] F. Frontini, T.E. Kuhn, S. Herkel, P. Strachan, G. Kokogiannakis, *Implementation of a new bi-directional solar modelling method for complex façades within the ESP-r building simulation program and its application*, Proceedings of the 11th International IBPSA Conference, 2009. Glasgow.
- [3] Frontini, F., Herkel, S., Kuhn, T.E. 2009. *Validation of a new method for solar control calculation in the ESP-r building simulation programme*, submitted for publication to Energy and Buildings.

Façade definition

The complex façade must be modelled as a double glaze system with a defined optical property (tmc file) that will be afterward replaced by the *bidata* file.

Instructions to assign controls for switching between different bidirectional datasets

In order to apply any type of bidirectional datasets controls, surfaces should be assigned with the bidirectional flag from the "Advanced Optics" menu as it was already done previously in ESP-r. Only the surfaces with this flag (use number 1 for this flag) will be assigned different datasets based on the information from the controls.

Two controls are available:

Method a: it uses the "standard" control algorithm as the "zone control" in ESP-r

Method b: it uses the predefined *.tdfa* file.

Controls - Method a:

An option for "optics" control has been developed with the same way as for the other control options in ESP-r. This can be found in the "Browse / Edit / Simulate" menu options. The users should click "optics" and then a typical process for the definition of ESP-r controls is initiated. First define a new control file or use an existing one and define day types for the first control loop. One control loop is added and can be viewed from the interface. The users should click on this control loop. The users then have the option to define sensor, actuator and period data.

Starting with the *sensor* data, the users have the option to sense: current zone dry bulb temperature, ambient dry bulb temperature, incident radiation at external surface and dry bulb temperature at any specific zone. There is also an option to sense lux levels but it is not recommended for use as it has not been tested in detail.

For the actuator data, the users can pick to control a construction. A list with all the constructions available in the constructions database of the model will be displayed.

After defining the *actuator*, the users should define the period data. One period is added by default (starting at 0.00 o'clock) but additional periods can be added. The users should click on the period of their interest and select the option to "switch bidirectional sets (setp. & set)". They will be then presented with the option to modify the period time (this is usually kept the same) and to define 6 setpoints and the corresponding number of 6 datasets that will be used if the sensed condition is above these setpoints. An example is given in Figure 1:

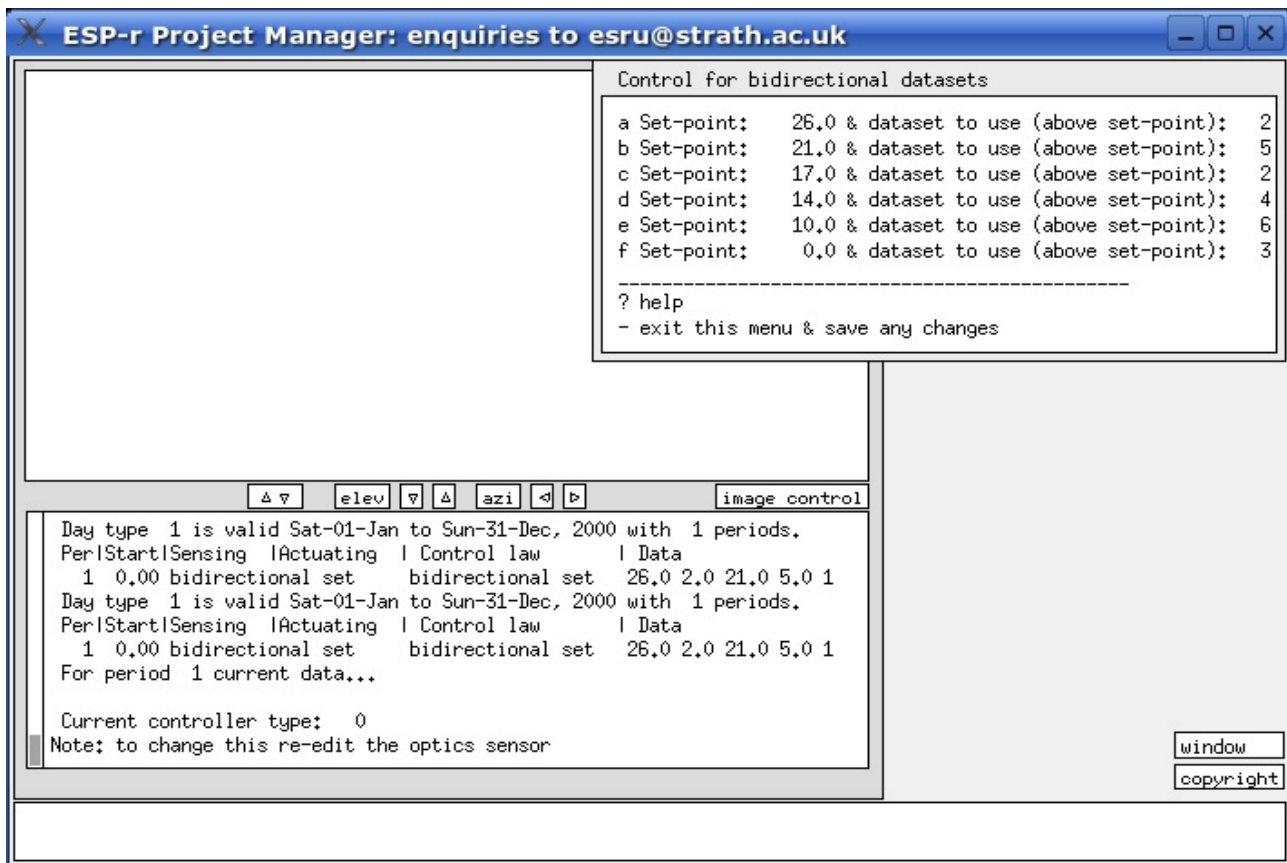


Figure 1: Example of setpoints and datasets definition

For the example of Figure 1 assume that the sensor is sensing external dry bulb temperature. If the outside temperature exceeds 0.0 °C the dataset number 3 will be used from the bidirectional data file. If the outside temperature exceeds 10.0 °C the dataset number 6 will be used from the bidirectional data file. It is the same case for the rest of the setpoints: dataset number 4 will be used above 14.0 °C, dataset number 2 will be used above 17.0 °C, dataset number 5 will be used above 21.0 °C and dataset number 2 will be used above 26.0 °C.

If there is nothing defined in this menu then dataset number 1 is always the default dataset.

Controls - Method b:

The second option is to use the *temporal definitions file* (.tdfa) to specify how the datasets should alternate at every timestep. This option can be accessed through the "Browse / Edit / Simulate" menu option by clicking on the "model context" and then on "impose measure data". The first time of the bidirectional controls definition in the temporal file, users should click on "create temporal entities file" and proceed to the "Temporal definitions" menu. Users should start from the top of the menu and click option 1. They will be asked for a file name (the default is usually OK) and to set up the initial data for it. A series of questions will be asked which they are used for the creation of the temporal file. After answering basic questions for the model, users are presented with the "Available TAB types" menu. A series of items that could take values from external files (e.g. measured data) are presented for this menu. The last option is "u Optical set: BIDIRSET" which is the one for the bidirectional datasets. Users will be asked for the name of this item and will be prompted back to the original "Temporal definitions" menu. They will then have to click on this item (e.g. option a) and they will enter the menu with the data. The first column is time and the second column in that menu is dataset number (default is 0). The easiest way to define the dataset numbers is by importing them from an external file. Click on the "Set display period or import raw data" option and then "import column data". Select of which timestep the import data would start (usually selecting "start @ temporal timestep one" is good enough) and then users are entered in the "Import specs" menu.

Define the name of the file (a csv file for example) that ESP-r would read to import the data (option 1). Specify which line the reading should start from (option 2) and the column number in that file (option a). Preview the start of the file by clicking "View start of import file" and if everything seems OK, click on the "Import data". Exit these menus and return to the "Temporal definitions" menu where you will need to select to save the file (from the available options select "Save ascii file". Additional items can be added to this menu. After exiting this menu, users are presented with the "Temporal file options: "menu" where they have to click on option "e manage associations" to connect their item with a surface in the model. Users should then "add association" and select the index number of the bidirectional item created previously. The feedback area in ESP-r shows at that stage the items and their index numbers (it may include additional temporal items specified by the users for other purposes). Users should then select the zone and the surface where the bidirectional datasets will switch according to what it has been specified in the item associated to them.

After associating items to surfaces, users should exit back to the "Browse / Edit / Simulate" menu where they should save their model.

If both control options exist for the same model "Method b" will be used during the simulation.

AUTHOR

Francesco Frontini, FhG-ISE Freiburg 2010

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