

Development of simulation models for building integrated solar systems: *aims, approaches and examples*

Annamaria Buonomano, Ph.D.

Dept. of Industrial Engineering University of Naples Federico II, Italy (annamaria.buonomano@unina.it)

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Со	ntent:		
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A thermal network is usually adopted for modelling thermal system (based on the assumption of one dimensional modelling of the occurring thermal phenomena)



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The higher the number of nodes, the higher the order of the system... and its complexity too!



...building energy model of appropriate resolution (order, modeling detail) and weather + occupancy forecasts, we can use the model for real time predictive control with fault detection and recovery...

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...writing a model...

- 1. Define the system, its components...
- 2. Define the level of detail, the inputs and outputs...
- 3. Formulate the mathematical model and assumptions...
- 4. Write the set of equations describing the model....
- 5. Solve the equations for the desired output variables....



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Modelling a **BISTS:** to assess the relationship between the building and the system, including both the passive and active effects due to the integration of the solar system on the building energy performance...





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Assumptions...

- Heat transfer is one-dimensional
- Indoor air is fully mixed (temperature is uniform)
- Indoor air is lumped in a single node, T_{in} and C_{in}
- The building envelope is lumped in a single node, *T*_{env} and *C*_{env}
- Homogeneous, isotropic and time-invariant thermophysical properties (density, specific heat and conductivity) are taken into account
- A linear system is modelled (linearized phenomena)









...tool?

Desktop Tools and Development Environment

Includes the desktop and command window, an editor, a code analyzer, a workspace, files, and other tools, browsers for viewing help

Mathematical Function Library

Numerous algorithms (e.g. elementary functions and complex arithmetic, matrix inverse, matrix eigenvalues and fast Fourier transforms, etc.)

Language

It is a high-level matrix-array language, including control flow statements, functions, data structures, input/output, and

object-oriented programming features

Graphics

Extensive facilities for displaying vectors and matrices as graphs, as well as editing and printing these graphs.









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	<pre>%%% Matrix_A.*x_T + Matrix_B.*u_T = 0 / %%% x_T = [Tpv_e, Tpv_i, Troof_e, Troof_i, Tair]; x_T = inv(Matrix_A)*(-Matrix_B)*u_T';</pre>	
<pre>&=eye(2); equation(1) = (equation(2) = (B=equation'; dydt=&\B;</pre>	((Tout - Tenv)/Req_ext + (Tin - Tenv)/Req_int + hr_op*A*(Tsky_WS-Tenv) + A*(abs_op*G_av)) / Cenv ((Tenv - Tin)/Req_int + (Tout - Tin)/Req_v + (Troof_i - Tin)/Rroof + Qgain + Qac) / Cinv;	; %Tenv %Tin
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... as a function of the specific question and objective, different models can be derived...



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technologies...

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Summary...

Importance of modelling - programming environments (e.g. MatLab) - is discussed

How to start writing a mathematical models (static and/or dynamic) of a BIPVT system in a simulation environment

The model can be suitably used to also carry out optimization and control analyses **Thank you...**