TYPE 581: MULTI DIMENSIONAL DATA INTERPOLATION

General Description

A generalized adaptation of Type42, this component can be used to model the performance of generic equipment or as a device to interpolate data in up to a four dimensions.

Detailed Description

This component performs a multi dimensional data interpolation with the limitation that there are between 1 and 4 independent variables and between 1 and 5 dependent variables. The model can be used as a pure data interpolation routine but can also be used equally well to model a piece of physical equipment whose performance can be characterized by 1 to 4 independent variables. This model is more general than Type42 in that the user is not limited in the precision in any of the independent variables. Furthermore, this component allows one more dimension of independent variables than does Type42.

If Type581 is used to model equipment then it should be kept in mind that the performance is determined from user-supplied steady-state data. Reduced performance associated with frequent cycling or other means of controlling capacity are not considered. These effects can be accounted for through the use of the Type43 Part Load Performance component.

It is also important to remember that Type581 *does not* extrapolate data beyond the range given in the external file. If the given conditions fall outside the range, then the last point given in the data file is returned. For example, if values of fluid flow rate are given based on a temperature difference and the maximum temperature difference in the data file is 15 C (corresponding to a fluid flow rate of 0.1 kg/hr) then for all temperature differences greater than 15 C, the fluid flow rate returned will be 0.1 kg/hr. No warning of these conditions is given.

The data interpolation or equipment is controlled by a single control input, Y. The values of the dependent variables output by this component are the product of each dependent variable evaluated at the current conditions and the control function. If Y is 0, then all outputs are 0. If Y is 1, then the outputs are the interpolated values from the user supplied data.

The data in the file is read and interpolated using subroutine DynamicData. It should be provided in a file accessed through a Fortran logical unit as outlined in Section 3.4.2 of Volume 1 of the TRNSYS documentation set. Data values for each dependent performance variable are required for each combination of independent variable values specified.

Examples

A series of examples follows:

Example 1: an ambient source heat pump whose heating capacity and COP depend only on the outdoor air temperature.

In this example, there are two dependent variables (heating capacity and COP) and one independent variable (outdoor air temperature). Let us say that we have 10 values of outdoor temperature; the data file must provide 10 values of COP and heating capacity. The values of the independent variable must

be provided in a single line while the values of the dependent variables must each be provided on their own lines. The exclamation point character indicates that all characters thereafter are to be ignored as a comment. The data file might look like the following:

```
-15  -10  -5  0  5  10  15  20  25  30    !values of ambient temperature
2.05  1.34                                 !Heating Capacity(kW) and COP(-) at -15
2.40  1.42                                 !Heating Capacity(kW) and COP(-) at -10
2.76  1.50                                 !Heating Capacity(kW) and COP(-) at -5
3.11  1.58                                 !Heating Capacity(kW) and COP(-) at 0
3.46  1.66                                 !Heating Capacity(kW) and COP(-) at 5
3.87  1.71                                 !Heating Capacity(kW) and COP(-) at 10
4.34  1.76                                 !Heating Capacity(kW) and COP(-) at 15
4.78  1.83                                 !Heating Capacity(kW) and COP(-) at 20
5.22  1.88                                 !Heating Capacity(kW) and COP(-) at 25
5.66  1.93                                 !Heating Capacity(kW) and COP(-) at 30
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Example 2: an air conditioner whose total cooling capacity and sensible cooling capacity depend upon the ambient dry bulb temperature and humidity ratio.

We now have two independent and two dependent values. Additionally, we must specify in the parameter list that there are 6 values of the first independent variable and 5 values of the second independent variable, keeping in mind that the independent variables are listed in reverse order; the first line contains the second independent variable values, the second line contains the first independent variable values.

```
0.001  0.0015  0.002  0.0025  0.003        !Outdoor air humidity ratio (C)
29.44  32.22  35.00  37.78  40.56  46.11   !Outdoor air dry bulb temperatures (C)
4.48  3.31              !Total Cooling(kW) and Sensible Cooling(kW) at 0.001\29.44
4.46  3.31              !Total Cooling(kW) and Sensible Cooling(kW) at 0.001\32.22
4.43  3.28              !Total Cooling(kW) and Sensible Cooling(kW) at 0.001\35
4.34  3.25              !Total Cooling(kW) and Sensible Cooling(kW) at 0.001\37.78
4.25  3.22              !Total Cooling(kW) and Sensible Cooling(kW) at 0.001\40.56
4.10  3.17              !Total Cooling(kW) and Sensible Cooling(kW) at 0.001\46.11
4.48  3.61              !Total Cooling(kW) and Sensible Cooling(kW) at 0.0015\29.44
4.46  3.58              !Total Cooling(kW) and Sensible Cooling(kW) at 0.0015\32.22
4.43  3.58              !Total Cooling(kW) and Sensible Cooling(kW) at 0.0015\35
4.34  3.52              !Total Cooling(kW) and Sensible Cooling(kW) at 0.0015\37.78
4.25  3.49              !Total Cooling(kW) and Sensible Cooling(kW) at 0.0015\40.56
4.10  3.46              !Total Cooling(kW) and Sensible Cooling(kW) at 0.0015\46.11
4.48  3.61              !Total Cooling(kW) and Sensible Cooling(kW) at 0.002\29.44
4.46  3.58              !Total Cooling(kW) and Sensible Cooling(kW) at 0.002\32.22
4.43  3.58              !Total Cooling(kW) and Sensible Cooling(kW) at 0.002\35
4.34  3.52              !Total Cooling(kW) and Sensible Cooling(kW) at 0.002\37.78
4.25  3.49              !Total Cooling(kW) and Sensible Cooling(kW) at 0.002\40.56
4.10  3.46              !Total Cooling(kW) and Sensible Cooling(kW) at 0.002\46.11
4.48  3.61              !Total Cooling(kW) and Sensible Cooling(kW) at 0.0025\29.44
4.46  3.58              !Total Cooling(kW) and Sensible Cooling(kW) at 0.0025\32.22
4.43  3.58              !Total Cooling(kW) and Sensible Cooling(kW) at 0.0025\35
4.34  3.52              !Total Cooling(kW) and Sensible Cooling(kW) at 0.0025\37.78
4.25  3.49              !Total Cooling(kW) and Sensible Cooling(kW) at 0.0025\40.56
4.10  3.46              !Total Cooling(kW) and Sensible Cooling(kW) at 0.0025\46.11
4.48  3.61              !Total Cooling(kW) and Sensible Cooling(kW) at 0.003\29.44
4.46  3.58              !Total Cooling(kW) and Sensible Cooling(kW) at 0.003\32.22
4.43  3.58              !Total Cooling(kW) and Sensible Cooling(kW) at 0.003\35
4.34  3.52              !Total Cooling(kW) and Sensible Cooling(kW) at 0.003\37.78
4.25  3.49              !Total Cooling(kW) and Sensible Cooling(kW) at 0.003\40.56
4.10  3.46              !Total Cooling(kW) and Sensible Cooling(kW) at 0.003\46.11
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Example 3: the temperature at a particular point on a plate depends upon the coordinates of the point and on the flow rate of air passing over the plate.

The coordinates of each point will be described by a distance away from the origin (requiring two independent variables). The flow rate of air passing over the plate requires a third independent variable. Only one dependent variable, the temperature at the point, is required. The plate is divided into a 4 element by 5 element grid.

```
0.5  1.5  2.5  3.5        !X position (m)
0.5  1.5  2.5  3.5  4.5   !Y position (m)
1  2  3                   !fluid flow rate (m/s)
20.2    !temperature of point (0.5,0.5) with an air flow rate of 1 m/s
20.1    !temperature of point (0.5,0.5) with an air flow rate of 2 m/s
20.0    !temperature of point (0.5,0.5) with an air flow rate of 3 m/s
20.3    !temperature of point (0.5,1.5) with an air flow rate of 1 m/s
20.2    !temperature of point (0.5,1.5) with an air flow rate of 2 m/s
20.1    !temperature of point (0.5,1.5) with an air flow rate of 3 m/s
20.4    !temperature of point (0.5,2.5) with an air flow rate of 1 m/s
20.3    !temperature of point (0.5,2.5) with an air flow rate of 2 m/s
20.2    !temperature of point (0.5,2.5) with an air flow rate of 3 m/s
20.5    !temperature of point (0.5,3.5) with an air flow rate of 1 m/s
20.4    !temperature of point (0.5,3.5) with an air flow rate of 2 m/s
20.3    !temperature of point (0.5,3.5) with an air flow rate of 3 m/s
20.6    !temperature of point (0.5,4.5) with an air flow rate of 1 m/s
20.5    !temperature of point (0.5,4.5) with an air flow rate of 2 m/s
20.4    !temperature of point (0.5,4.5) with an air flow rate of 3 m/s
...
```

The data would continue, following the same pattern. While there is a limit as to the number of independent and dependent variables provided, there is no limit as to the number of values provided for each independent variable.