RungeKutta Package

RKConditions[p, a, b, w]

creates the conditions that the Runge-Kutta method with Butcher array

```
c|a
---
 |b
```

must meet to be of order p. The quadrature conditions and conditions for row and column simplification are also computed. Continuous conditions are possible using the option Continuous. b and c are assumed to be vectors of the same size and a should be a square matrix with dimension the same as b & c. a, b and c need not be defined before evaluating **RKConditions.** In this case only the conditions are computed and they are given in terms of scalar multiplications and dot products.

Options

- **CondName:** The i-th condition is named CondName[i]. The default name is cond.
- **QuadName:** The i-th quadrature condition is named QuadName[i]. The default name is qcond.
- **ColumnName:** The i-th column simplifying assumption is named ColumnName[i]. This is a list whose j-th element may be referenced with ColumnName[i,j]. The default name is ccond.
- **RowName:** The i-th row simplifying assumption is named RowName[i]. This is a list whose j-th element may be referenced with RowName[i,j]. The default name is rcond.
- **Continuous:** If set to anything other than False then the value is assumed to be the variable used for continuous order conditions. The default is False.
- **EndPointOrder:** specifies the order that continuous order conditions should attain at their end points. The default value is p+1, where p is the order requested in **RKConditions.**
- **RowOrder:** specifies the order of the row simplifying assumptions. The default is p, where p is the order requested in **RKConditions.**
- **ColumnOrder:** specifies the order of the column simplifying assumptions. The default is p, where p is the order requested in **RKConditions.**

Order[treenumber]

gives the number of vertices in the given tree. See Butcher page 88.

Alpha[treenumber]

gives the number of ways of labelling the given tree with a totally ordered set V (with #V = Order[treenumber]) in such a way that if (m,n) is an edge then m<n. See Butcher page 92.

Beta[treenumber]

gives the number of ways of labelling the given tree with Order[treenumber]-1 distinct labels on condition that the root is not labelled but every other vertex is. See Butcher page 91.

BetaBar[treenumber]

gives the number of ways of labelling the given tree with Order[treenumber] distinct labels on condition that every vertex is labelled. See Butcher page 91.

Density[treenumber]

gives the density of the given tree. See Butcher page 88.

Height[treenumber]

gives 1 plus the length of the longest path in the given tree. See Butcher page 88.

Width[treenumber]

gives the number of terminal vertices of the given tree. See Butcher page 88 (widthbar version).

ShowTree[treenumber]

draws a picture of the given tree. It also displays the text produced by the **ShowText** option. **ShowTree[list]** produces a graphics array containing pictures of each of the trees in **list**.

<u>Options</u>

- **Columns:** specifies the number of columns to use in **ShowTree[list]**. The default is 5.
- **NodeSize:** specifies the size of the nodes as a fraction of the width of the picture. The default is 0.025.
- **ShowText:** If **ShowText** is None then no textual output is displayed with the trees. Otherwise **ShowText** is assumed to be the name of a function that produces Graphics output. The function should be of the form name[treenumber, height, fontsize] where height is the height of the picture which is not necessarily the height of the tree. The default function is **NumberAndDensity.** (This option is mostly for the future.)
- **FontSize:** specifies the size of the text used in **ShowTree**. The default is 18 for **ShowTree[treenumber]** and 10 for **ShowTree[list]**.
- **AspectRatio:** gives is the aspect ratio used for the final picture in ShowTree. The default is 11/8.5

FindDensity[n]

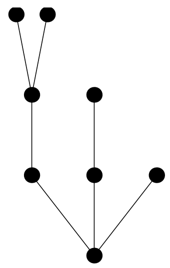
gives a list of the currently defined trees whose density is n.

NumberOfTrees[p]

gives a list of two lists. The i-th element of the first sublist is the number of trees (conditions) of order p, whilst the i-th element of the second sublist gives the number of trees (conditions) of order at most p.

TreeToNumber[tree]

gives the number of the tree **tree**. **tree** is constructed as follows: Braces, {}, represent joining the roots of the trees enclosed within the braces to a common root. A number, n, represents n nodes. So, for example, {{{2}}, {1}, 1} represents the tree



NumberToTree[treenumber]

gives a construction of the tree numbered **treenumber**. The construction is as for **TreeToNumber**.