NAG Toolbox for MATLAB

d02qy

1 Purpose

d02qy is a diagnostic function which may be called after a call to the integrator functions d02qf or d02qg.

2 Syntax

```
[index, itype, events, resids, ifail] = d02qy(neqg, rwork, iwork, 'lrwork', lrwork, 'liwork', liwork)
```

3 Description

d02qy should be called only after a call to d02qf or d02qg results in the output value **root** = **true**, indicating that a root has been detected. d02qy permits you to examine information about the root detected, such as the indices of the event equations for which there is a root, the type of root (odd or even) and the residuals of the event equations.

4 References

None.

5 Parameters

5.1 Compulsory Input Parameters

1: **neqg – int32 scalar**

the number of event functions defined for the integration function. It must be the same parameter **neqg** supplied to the setup function d02qw and to the integration function (d02qf or d02qg).

2: **rwork**(**lrwork**) **– double array**

This **must** be the same parameter **rwork** as supplied to d02qf or d02qg. It is used to pass information from the integration function to d02qy and therefore the contents of this array **must not** be changed before calling d02qy.

3: **iwork**(**liwork**) **– int32 array**

This **must** be the same parameter **iwork** as supplied to d02qf or d02qg. It is used to pass information from the integration function to d02qy and therefore the contents of this array **must not** be changed before calling d02qy.

5.2 Optional Input Parameters

1: **lrwork – int32 scalar**

Default: The dimension of the array **rwork**.

This must be the same parameter **lrwork** as supplied to d02qw.

2: **liwork – int32 scalar**

Default: The dimension of the array **iwork**.

This must be the same parameter **liwork** as supplied to d02qw.

5.3 Input Parameters Omitted from the MATLAB Interface

None.

5.4 Output Parameters

1: **index – int32 scalar**

The index k of the event equation $g_k(x, y, y') = 0$ for which the root has been detected.

2: **itype – int32 scalar**

Information about the root detected for the event equation defined by **index**. The possible values of **itype** with their interpretations are as follows:

itype $= 1$

A simple root, or lack of distinguishing information available.

itype $= 2$

A root of even multiplicity is believed to have been detected, that is no change in sign of the event function was found.

itype $= 3$

A high-order root of odd multiplicity.

itype $= 4$

A possible root, but due to high multiplicity or a clustering of roots accurate evaluation of the event function was prohibited by round-off error and/or cancellation.

In general, the accuracy of the root is less reliable for values of **itype** > 1.

3: **events(neqg) – int32 array**

Information about the kth event function on a very small interval containing the root, **t** (see d02qf and d02qg), as output from the integration function. All roots lying in this interval are considered indistinguishable numerically and therefore should be regarded as defining a root at **t**. The possible values of **events**(k) with their interpretations are as follows:

events$(k) = 0$

The kth event function did not have a root.

events$(k) = -1$

The kth event function changed sign from positive to negative about a root, in the direction of integration.

events$(k) = 1$

The kth event function changed sign from negative to positive about a root, in the direction of integration.

events$(k) = 2$

A root was identified, but no change in sign was observed.

4: **resids(neqg) – double array**

The value of the kth event function computed at the root, **t** (see d02qf and d02qg).

5: **ifail – int32 scalar**

0 unless the function detects an error (see Section 6).

6 Error Indicators and Warnings

Errors or warnings detected by the function:

ifail = 1

An integration function (d02qf or d02qg) has not been called, no root was detected or one or more of the parameters **lrwork**, **liwork** and **neqg** does not match the corresponding values supplied to d02qw. Values for the arguments **index**, **itype**, **events** and **resids** will not have been set.

This error exit may be caused by overwriting elements of **iwork**.

7 Accuracy

Not applicable.

8 Further Comments

None.

9 Example

d02qf_fcn.m

```
function f = fcn(neqf, x, y)
  f=zeros(neqf,1);
  f(1)=y(2);
  f(2)=-y(1);
```

d02qf_g.m

```
function result=g(neqf, x, y, yp, k)
  if (k == 1)
    result = yp(1);
  else
    result = y(1);
  end
```

```
t = 0;
y = [0; 1];
tout = 10;
rwork = zeros(97,1);
iwork = zeros(29, 1, 'int32');
neqf = int32(2);
neqg = int32(2);

[statefOut, altergOut, rwork, iwork, ifail] = ...
     d02qw('S', int32(2), true, [1e-06;1e-06], [0.0001; 0.0001], false,
true, ...
    10, 0, int32(0), int32(2), false, true, rwork, iwork);
[t, y, root, rwork, iwork, ifail] = ...
    d02qf('d02qf_fcn', t, y, tout, 'd02qf_g', neqg, rwork, iwork);
[yp, tcurr, hlast, hnext, odlast, odnext, nsucc, nfail, tolfac, badcmp,
ifail] = ...
    d02qx(neqf, rwork, iwork);
[index, itype, events, resids, ifail] = d02qy(neqg, rwork, iwork)
```

```
index =
           2
itype =
           1
```

```
events =
           0
           2
resids =
     1
     0
ifail =
           0
```