edgetest

Purpose

Test for robust stability of a polynomial family whose coefficients depend affinely on the vector of uncertain parameters. The set of possible uncertain parameters is a box in the space od parameters. The function accepts both continuous and discrete polynomials as input arguments.

Syntax

```
y = edgetest(p0,p1,p2,…,pk,Qbounds)
```

Description

The command

```
y = edgetest(p0,p1,p2,…,pk,Qbounds)
```

returns 1 if the polynomial family described by

$$p(s,\mathbf{q}) = p_0(s) + q_1 p_1(s) + q_2 p_2(s) + \ldots + q_k p_k(s)$$

is robustly stable with

$$q_1 \in \left[q_1^-, \quad q_1^+\right]$$
$$q_2 \in \left[q_2^-, \quad q_2^+\right]$$
$$\vdots$$
$$q_k \in \left[q_k^-, \quad q_k^+\right]$$

which is input as

```
Qbounds = [q1min, q1max; q2min, q2max;…; qkmin, qkmax];
```

The function returns 0 if the polynomial family is not robustly stable.

Examples

Consider the uncertain polynomial given by

$$p(s,q) = p_0(s) + q_1 p_1(s) + q_2 p_2(s)$$

where

$$p_0(s) = 2 + s + 4s^2 + s^3 + s^4,\ p_1(s) = 1 + 2s^2,\ p_2(s) = -2 + s - s^2 + 2s^3$$

and

$$q_1 \in [-0.5, 2], \quad q_2 \in [-0.3, 0.3].$$

We simply type

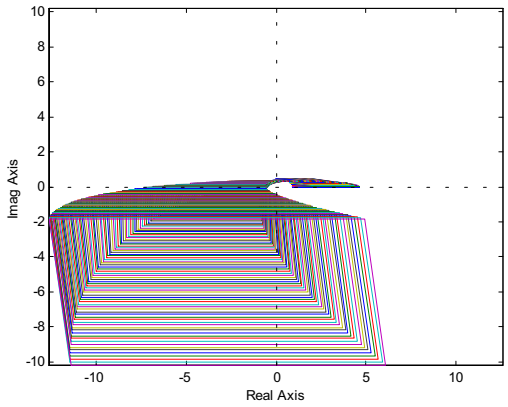
```
p0 = pol([2 1 4 1 1],4);
p1 = pol([1 0 2],2);
p2 = pol([-2 1 -1 2],3);
Qbounds = [-0.5 2; -0.3 0.3];

edgetest(p0,p1,p2,Qbounds)

ans =
     1
```

Thus the polynomial is guaranteed to remain stable for all amissible values of the uncertain parameters. We can check this result graphically with **ptopplot** function, which plots the value set of the uncertain polynomial for a given frequency range.

```
ptopplot(p0,p1,p2,Qbounds,j*(0:0.01:2))
```



Our previous conclusion about the robust stability is thus confirmed because the value set does not include the origin.

Algorithm

The function **edgetest** is based on Bartlett's Edge Theorem ([1], pp.153). It internally calles a function **ptopex** which gives a set of generators for a polytope of polynomials. Then it applies Bialas' Eigenvalue Theorem ([1], pp.55) for testing the polynomials on the edge of the polytope; this is accomplished with **stabint** function.

See also

ptopex	Set of generators for a polytope of polynomials.
ptoplot	Plot the value sets for a polytopic polynomial family.

References

[1] R. Barmish: *New Tools for Robustness of Linear Systems.* Macmillan Publishing Company. New York, 1994.