Function Reference

feedback

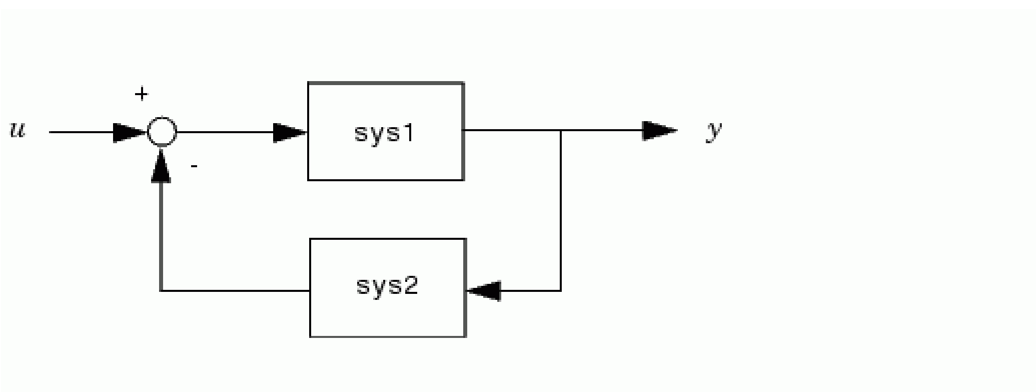
Feedback connection of two LTI models

Syntax

```
sys = feedback(sys1,sys2)
sys = feedback(sys1,sys2,sign)
sys = feedback(sys1,sys2,feedin,feedout,sign)
```

Description

`sys = feedback(sys1,sys2)` returns an LTI model `sys` for the negative feedback interconnection.



The closed-loop model `sys` has u as input vector and y as output vector. The LTI models `sys1` and `sys2` must be both continuous or both discrete with identical sample times. Precedence rules are used to determine the resulting model type (see Precedence Rules).

To apply positive feedback, use the syntax

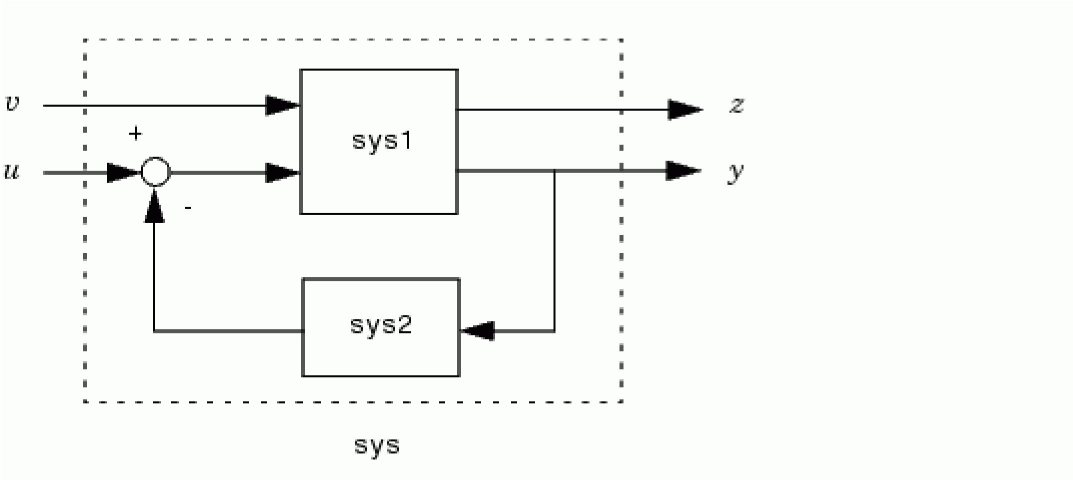
```
sys = feedback(sys1,sys2,+1)
```

By default, `feedback(sys1,sys2)` assumes negative feedback and is equivalent to `feedback(sys1,sys2,-1)`.

Finally,

```
sys = feedback(sys1,sys2,feedin,feedout)
```

computes a closed-loop model `sys` for the more general feedback loop.



The vector `feedin` contains indices into the input vector of `sys1` and specifies which inputs u are involved in the feedback loop. Similarly, `feedout` specifies which outputs y of `sys1` are used for feedback. The resulting LTI model `sys` has the same inputs and outputs as `sys1` (with their order preserved). As before, negative feedback is applied by default and you must use

```
sys = feedback(sys1,sys2,feedin,feedout,+1)
```

to apply positive feedback.

For more complicated feedback structures, use `append` and `connect`.

Remark

You can specify static gains as regular matrices, for example,

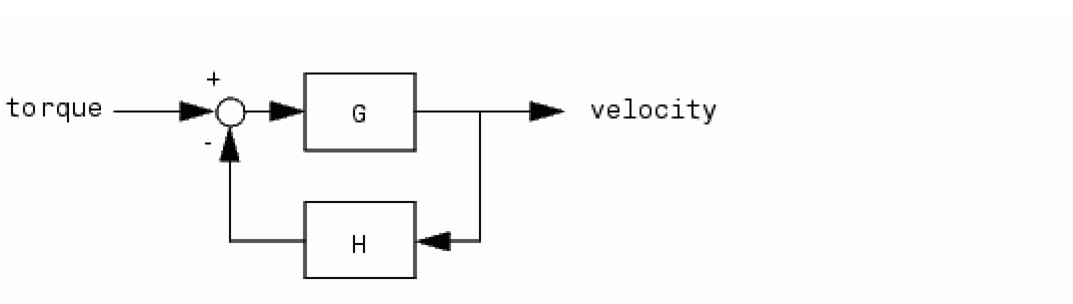
```
sys = feedback(sys1,2)
```

However, at least one of the two arguments `sys1` and `sys2` should be an LTI object. For feedback loops involving two static gains `k1` and `k2`, use the syntax

```
sys = feedback(tf(k1),k2)
```

Examples

Example 1



To connect the plant

$$G(s) = \frac{2s^2 + 5s + 1}{s^2 + 2s + 3}$$

with the controller

$$H(s) = \frac{5(s+2)}{s+10}$$

using negative feedback, type

```
G = tf([2 5 1],[1 2 3],'inputname','torque',...
                              'outputname','velocity');
H = zpk(-2,-10,5)
Cloop = feedback(G,H)
```

and MATLAB returns

```
Zero/pole/gain from input "torque" to output "velocity":
0.18182 (s+10) (s+2.281) (s+0.2192)
-----------------------------------
 (s+3.419) (s^2 + 1.763s + 1.064)
```

The result is a zero-pole-gain model as expected from the precedence rules. Note that `Cloop` inherited the input and output names from `G`.

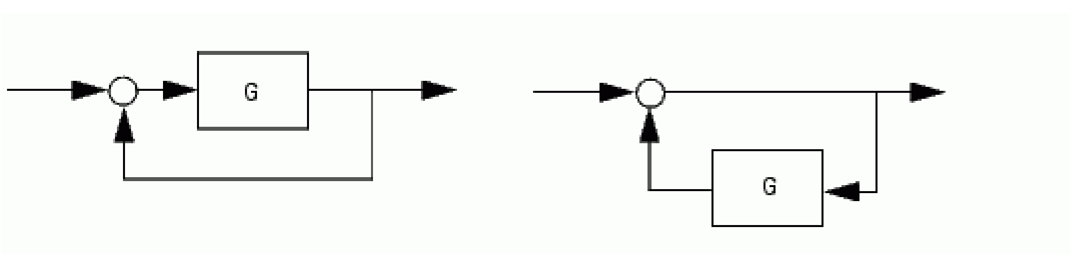
Example 2

Consider a state-space plant `P` with five inputs and four outputs and a state-space feedback controller `K` with three inputs and two outputs. To connect outputs 1, 3, and 4 of the plant to the controller inputs, and the controller outputs to inputs 4 and 2 of the plant, use

```
feedin = [4 2];
feedout = [1 3 4];
Cloop = feedback(P,K,feedin,feedout)
```

Example 3

You can form the following negative-feedback loops



by

```
Cloop = feedback(G,1)     % left diagram
Cloop = feedback(1,G)     % right diagram
```

Limitations

The feedback connection should be free of algebraic loop. If D_1 and D_2 are the feedthrough matrices of `sys1` and `sys2`, this condition is equivalent to:

- $I + D_1 D_2$ nonsingular when using negative feedback
- $I - D_1 D_2$ nonsingular when using positive feedback.

See Also

`series`	Series connection
`parallel`	Parallel connection
`connect`	Derive state-space model for block diagram interconnection

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