Calculation of zeros in Vector Fitting

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Bjørn Gustavsen and Adam Semlyen

In Vector Fitting, the new poles are calculated as the zeros of σ(s) where σ(s) is a rational, scalar function

$$\sigma(s) = \frac{y(s)}{u(s)} = \sum_m \frac{c_m}{s-a_m} + 1 = \frac{\Pi(s-z_m)}{\Pi(s-a_m)} \tag{1}$$

From (1) we see that the zeros of σ (*s*) is equal to the poles of 1/σ (*s*). The inverse of σ (*s*) we can obtain by interchanging the input (*u*) with output (*y*). To do this, we look at (1) in the time domain:

$$\dot{x} = Ax + bu \tag{2a}$$
$$y = cx + du \tag{2b}$$

where *A* is a diagonal matrix holding the elements $\{a_m\}$, *c* is a row-vector holding the elements $\{c_m\}$, *d* is unity, and *b* is a column of one's.

From (2b) we get:

$$u = d^{-1}(y - cx) \tag{3}$$

Inserting (3) into (2a) we get

$$\dot{x} = Ax + bd^{-1}(y - cx) = (A - bd^{-1}c)x \tag{4}$$

In σ, *d*=1 and so we get:

$$\dot{x} = (A - bc)x = \tilde{A}x \tag{5}$$

The poles are equal to the eigenvalues of $\tilde{A}$ and so we have that the zeros of σ are equal to eig(*A*-*bc*).