

# Subspace Identification (SSID) Example

CEE 699.04, ME 599.04 — System Identification — Fall, 2013

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A continuous-time realization ( $n = 8$ ,  $r = 1$ ,  $m = 2$ ).

$$\left[ \begin{array}{c|c} A_c & B_c \\ \hline C & D \end{array} \right] \sim \left[ \begin{array}{cccccc|cccc} 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 1 & 0 \\ -2500 & 1000 & 0 & 0 & -5 & 1 & 0 & 0 & -100 \\ 500 & -1000 & 500 & 0 & 1 & -3 & 1 & 0 & -50 \\ 0 & 333 & -667 & 333 & 0 & 0 & -2 & 0 & -33 \\ 0 & 0 & 250 & -500 & 0 & 0 & 0 & -1 & -25 \end{array} \right]$$

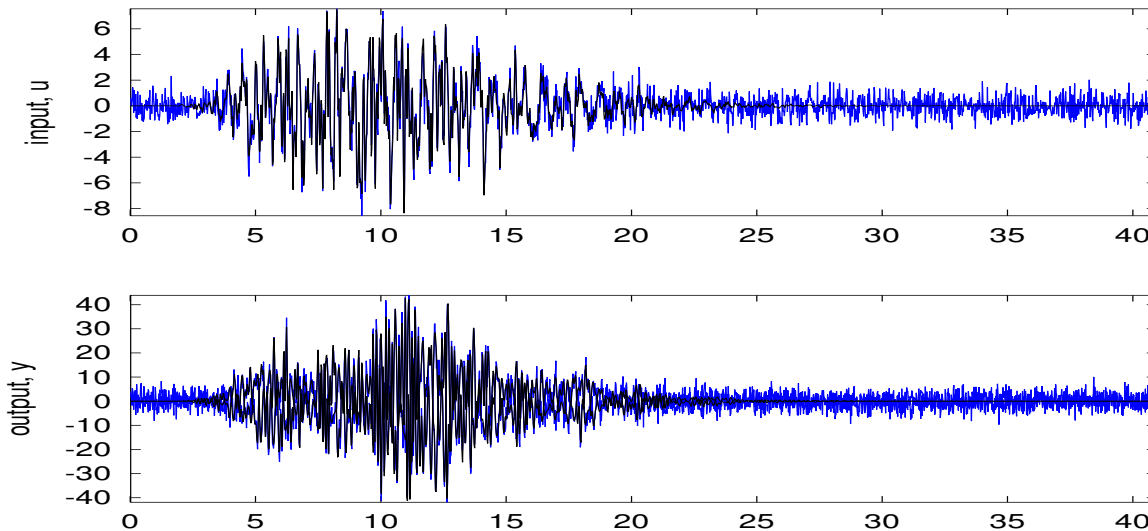
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$$\left[ \begin{array}{cccccc|cc} 0 & 0 & 0 & 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & -1 & 1 \end{array} \right] \quad \left[ \begin{array}{c} 0 \\ 0 \end{array} \right]$$

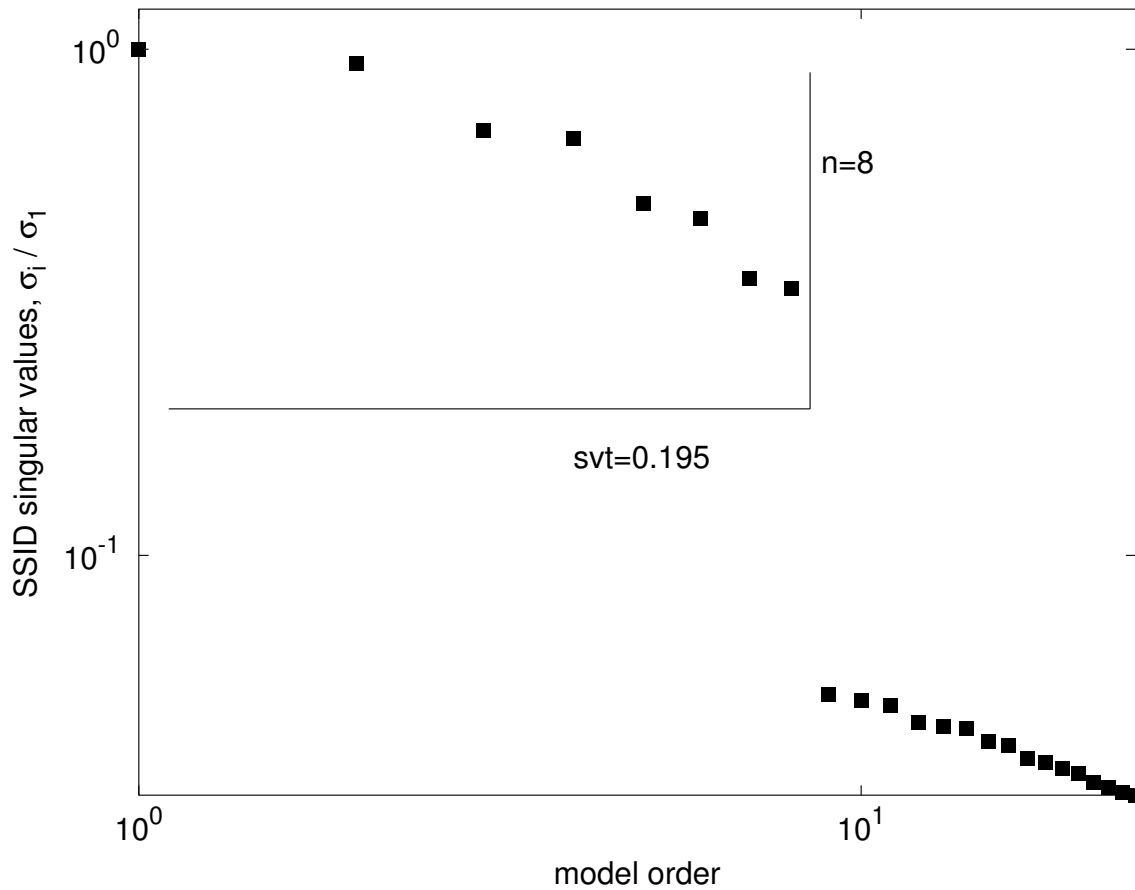
True model dynamics

Natural Frequency (cyc/sec)	Damping	Damped Frequency (cyc/sec)	Eigenvalue real	imag
1.92593	0.06539	1.92180	-0.79133	12.07504
3.74617	0.03368	3.74404	-0.79276	23.52451
5.22585	0.03658	5.22235	-1.20119	32.81299
7.77751	0.05555	7.76550	-2.71472	48.79207

$\Delta t = 0.020$ s; input msmnt noise PSD = 0.050; output msmnt noise PSD = 0.005



## SSID identified model dynamics



K = 30; % number of block rows in SSID block Hankel data matrices  
 svt = 8; % specified order of the system for SSID

Natural Frequency (cyc/sec)	Damping	Damped Frequency (cyc/sec)	Eigenvalue real	imag
1.93365	0.06129	1.93002	-0.74467	12.12666
3.74419	0.03644	3.74170	-0.85735	23.50981
5.24156	0.04084	5.23718	-1.34494	32.90619
7.78449	0.04950	7.77495	-2.42113	48.85144

OKID identified model dynamics

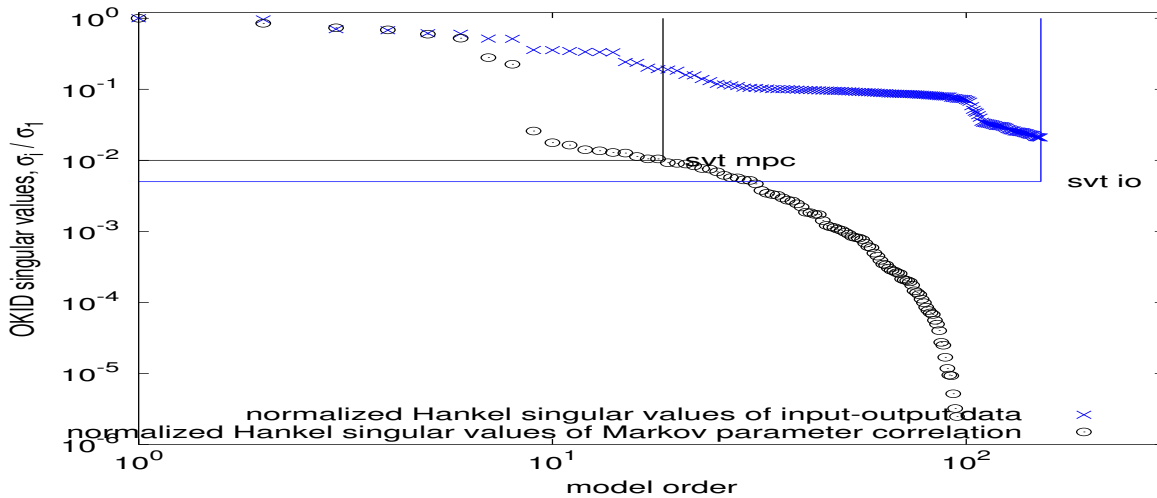
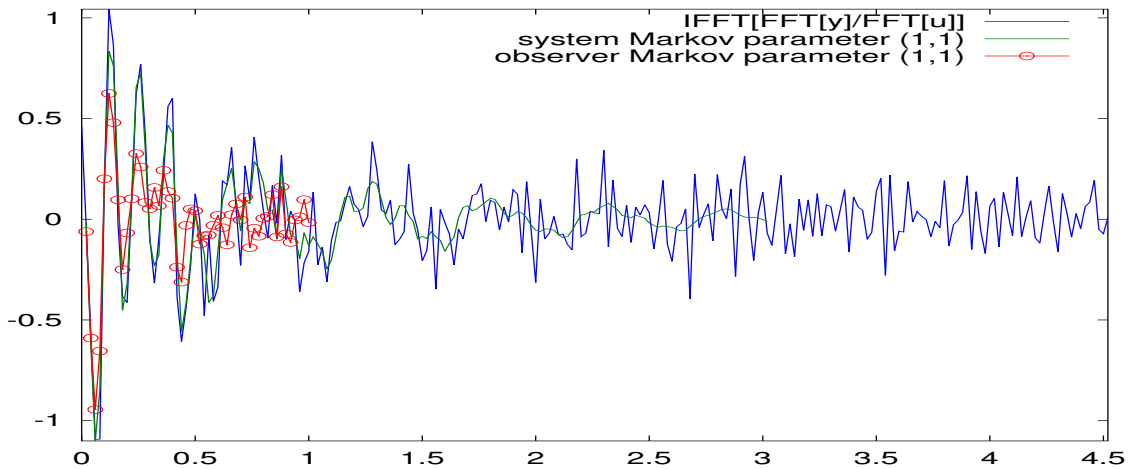
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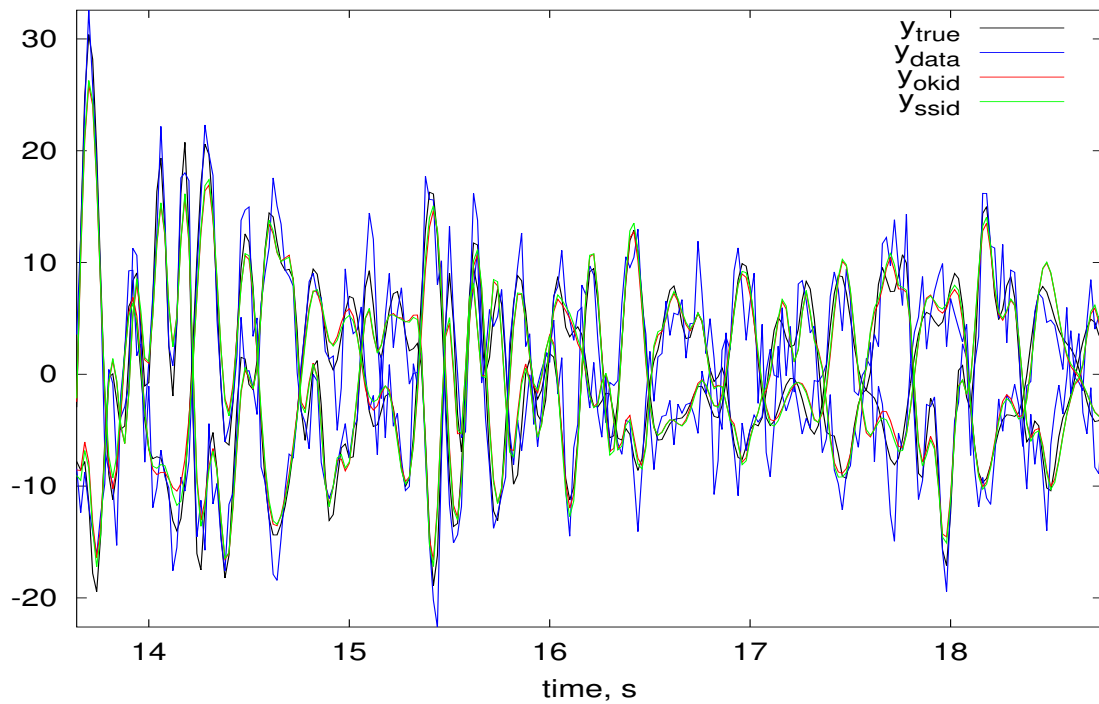
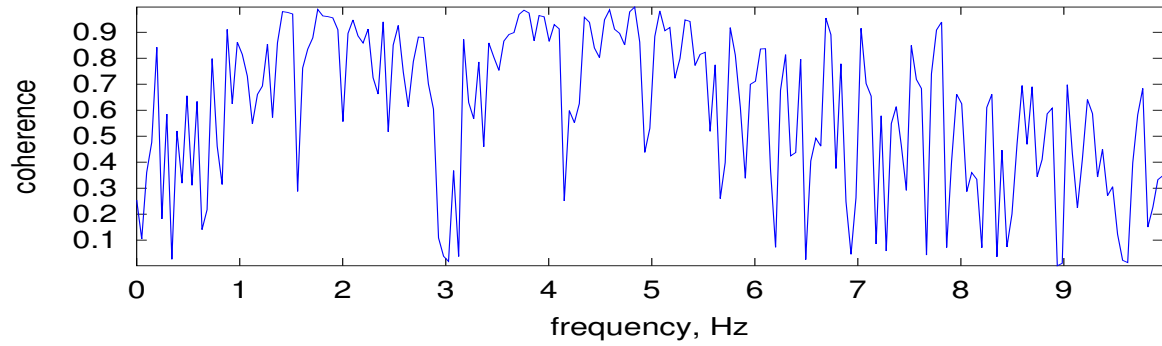
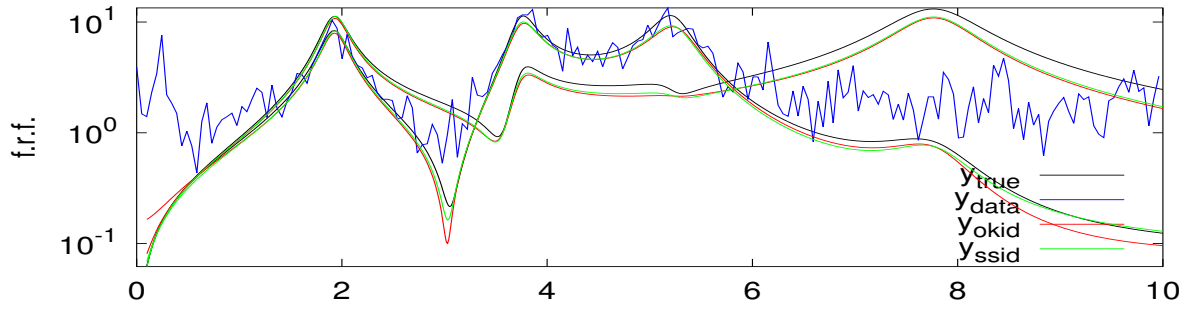
p = 50;           % number of observer Markov parameters
svt_io = 0.005;  % singular value ratio threshold for input-output data
svt_mpc = 0.010; % singular value ratio threshold for Markov param. correlation
mact    = 0.9;   % threshold for modal amplitude correlations
    
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Natural Frequency (cyc/sec)	Damping	Damped Frequency (cyc/sec)	Eigenvalue	
			real	imag
1.93099	0.06314	1.92713	-0.76611	12.10854
3.75060	0.03770	3.74794	-0.88842	23.54898
5.25845	0.04218	5.25377	-1.39351	33.01040
7.78411	0.04885	7.77482	-2.38902	48.85061

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MAC = 0.975    0.936    0.960    0.904
MSV = 3.668    3.176    2.996    3.257
    
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||y_meas - y_true|| / ||y_true|| . . . 0.285
||y_okid - y_true|| / ||y_true|| . . . 0.266
||y_okid - y_meas|| / ||y_true|| . . . 0.480
||y_ssid - y_true|| / ||y_true|| . . . 0.262
||y_ssid - y_meas|| / ||y_true|| . . . 0.479

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