Cantilever plate

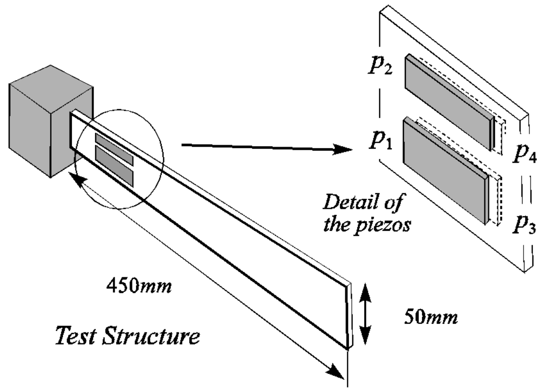

Figure 1: Cantilever plate with piezoceramics: experimental setup

Consider the cantilever plate represented on Figure 1; the steel plate is 0.5 *mm* thick and four piezoceramic strips of 250 μm thickness are bounded symmetrically as indicated in the figure. The size of the piezos is respectively 55 $mm \times 25$ mm for p_1 and p_3, and 55 $mm \times 12.5$ mm for p_2 and p_4. p_1 is used as actuator while the sensor is taken successively as p_2, p_3 and p_4. The experimental transfer functions between a voltage applied to p_1 and the electric charge appearing successively on p_2, p_3 and p_4 when they are connected to a charge amplifier are shown on Figure 2.

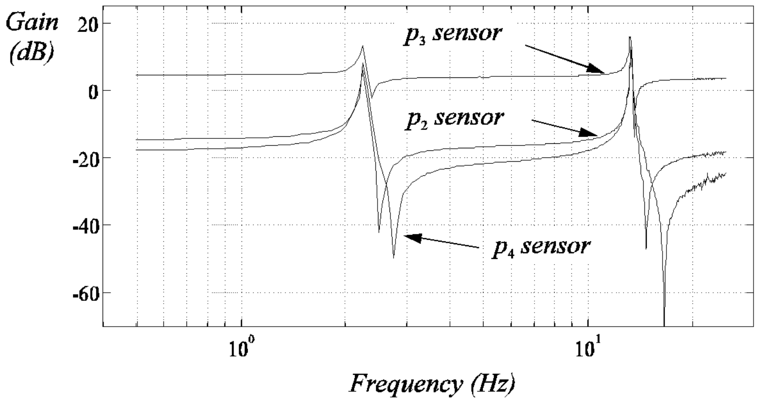

Figure 2: Experimental results

We note that the transfer functions, particularly the location of the zeros, vary substancially from one configuration to the other. This is because the transfer functions of nearly collocated control systems are very much dependant on local effects, in particular the membrane strain in the thin steel plate between the piezo patches.

The modal properties of the system are determined by a dynamic analysis and exported into the *Matlab-Simulink* package to compute the transfer functions. A

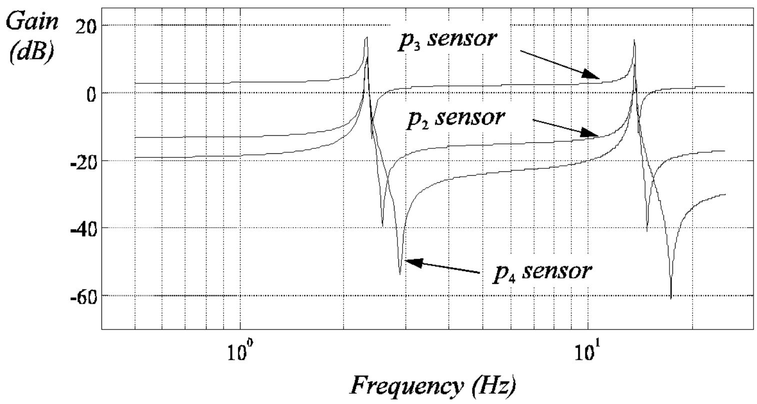

Figure 3: Simulation results

block-system of the structure containing the piezotransducers is easily deduced. It can be used to design various control strategies which can be implemented and tested on the laboratory test structure using a *DSP* processor. Figure 3 shows the numerical results corresponding to the three sensor configurations (a modal damping ratio of $\xi = 0.5\%$ was assumed in the numerical simulations); they agree reasonably well with the experiments. The study was conducted with the three meshes of Figure 4. Surprisingly, no significant difference appears in the transfer functions which are almost identical; this can be further assessed from Table 1 which compares the frequency difference between the poles and zeros of the configuration (p_1/p_3) for the three meshes.

	$\Delta\omega_1/\omega_1$	$\Delta\omega_2/\omega_2$
Mesh 1	0.0340	0.0618
Mesh 2	0.0340	0.0610
Mesh 3	0.0339	0.0614
Experiment	0.0455	0.0674

Table 1: Influence of the mesh on the separation between the poles and the zeros (p_1/p_3)

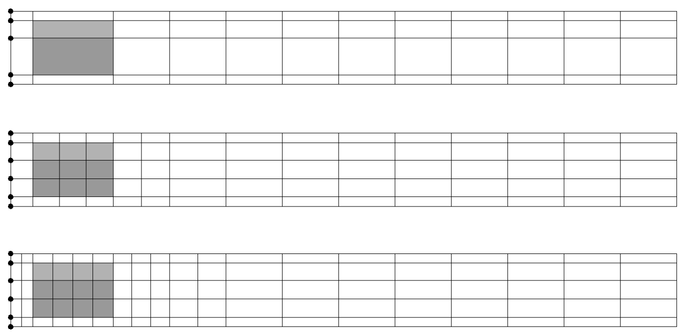

Figure 4: *FE* meshes