Quietening Newspaper Printing Presses by Active Control

C.F.Ross

Topexpress Limited

Measurements made on 11 April 1980, at Northcliffe House on the noise produced by the printing of the "Evening News" showed that a local sound level could theoretically be reduced by some 6 dB. It was thought possible that if this 6 dB could be achieved in practice, then active control would be useful in combatting the press noise, particularly so when used in conjunction with a passive screen. The passive screen would surround most of the printing press but a few holes would be left for access to the controls and delivery of the printed articles. Most of the direct higher frequency sound would be attenuated by the screen but the lower frequency sound would still escape through the holes where it could be combatted by Active Control. A demonstration was planned at Timsons Perfecta Works to show how close a practical active control system, built using existing technology, and working on a printing press, could approach the theoretical limits It was hoped that, with the information on the performance at Timsons, an estimate could be than made of the probably performance on the "Evening News" press.

Two types of active control system are appropriate to the press problem; a "random noise" and a "repetitive noise" controller.

1 A random noise controller has, as an input, a measure of the press noise. The input signal is filtered in the controller to give an output that drives loudspeaker and thus produces the antisound. The input signal is chosen to have the highest possible degree of coherence with the sound in the area where cancellation is desired.

2 Our repetitive controller is driven by a clock signal derived from the speed of the press. The signal is in two parts, a pulse, once per revolution of the machine that ensures the controller is in synchronisation with the machine, and a series of N pulses per revolution which tells the controller to make the correct antisound for each part of the cycle. The number of pulses per cycle, N, is equal to twice the maximum harmonic that can be cancelled (i.e. if N = 200 then up to the 100th harmonic can be cancelled - this would correspond to 500 Hz for a machine with a speed of 5 cycles per second).

The theoretical limits on the performance of the two types of active control system were estimated. The particular printing press used was running at 9000 Copies per Hour (185.3 metres/min).

Quietening Newspaper Printing Presses by Active Control

1 Random controller

Two types of input were considered for this controller and they were selected on their ability to attenuate the radiated sound.

Accelerometer input

Since the printing press makes sound by vibration a measure of this vibration should be related to the sound produced. The acceleration of 5 distinct points on the machine was monitored and the maximum attenuation possible in the frequency band 0-500 Hz was found on this machine in its existing environment to be:-

Position	Attenuation
1	4.3 dB
2	4.5 dB
3	3.4 dB
4	4.3 dB
5	3.2 dB

Microphone input

Using a microphone positioned very close to the machine as input the maximum attenuation was found to be 8.2 dB (almost independent of the exact position).

The poorer performance of acceleration signals compared with near field sound measurements in predicting radiated noise is not unexpected. The far field sound is produced by vibration of the whole machine and a measure of the movement of one panel is unlikely to give a good picture of the whole. A better signal may have been obtained by taking a weighted average of many accelerometers positioned on different panels of the machine but the added complexity did not seem worthwhile when the near field sound measurements were significantly better.

2 Repetitive controller

It was shown that some 6 dB of the noise in the frequency band 0-500 Hz was exactly repeated each machine cycle and this could be eliminated.

Neither of the two schemes stood out as being much better than the other and so a controller of each type was tried. The random method has been developed over the past three years and is thus well tried. The main limitation on the method is that the input signal must be received a short time before the sound reaches the cancellation region in order to allow for processing time. This

Quietening Newspaper Printing Presses by Active Control

is a serious problem in printing presses where the passive screen must be positioned very close to the press because the separation between the region of generation of the sound and the region where the cancellation is required is small.

In the limited time available for the demonstration, the best results were obtained with a microphone placed 8 inches on the machine side of the screen and a pair of loudspeakers 8 feet from the other side.

The following results were achieved in that configuration:

Octave Band (Hz)	With Control (dB level)	Without Control (dB level)	Improvement (dB)
63	63	63	0
125	67	68	1
250	77	84	7
500	75	76	1
1000	71	71	0
Linear	80	84.5	4.5

With the loudspeakers moved closer to the screen (4 feet away) the reduction was reduced to 6 dB in the 250 Hz octave band and with them 1 foot 6 inches away only 3 dB was achieved in that band.

The area of cancellation was rather small with these large distances separating the source and control loudspeakers because much of the sound was coming around the screen as well as through the hole. The filter ideally required for the controller was extremely complex and the actual filter used was a good match only for one particular speed of the machine; for other speeds the match was poorer and so the performance of our device was seriously affected by fluctuations of the machine speed.

A repetitive controller synchronised to the machine should be less sensitive to speed fluctuations. With the loudspeakers positioned close to the exit slot a reduction of 4 dB in the 250 Hz octave band was demonstrated using the repetitive device. (The controller had 392 pulses per revolution and the machine speed was 2.5 cycles per second. The controller was thus capable of functioning up to 500 Hz). This poorer performance than expected was due to our limited experience in designing repetitive controllers to be insensitive to beackground noise which in this case came from other parts of the machine shop. It was clear that this could have been much better if the experiment had been performed in a quieter environment.

Subsequently superior algorithms have been developed which admirably overcome this problem and would have performed much closer to the theoretical maximum of 6dB in the 500 Hz band. The repetitive controller was found to be less susceptible to machine speed fluctuations and so it was concluded that this type would be far superior to a "random controller". It was also shown that the performance in practise is not significantly poorer than the theoretical maximum predicted from coherence measurements. These conclusions have given confidence that a well designed controller fitted to a newspaper press in Fleet Street used in conjunction with a passive screen would produce useful sound attenuation.