The Interference Index:

Prediction and Verification

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Abstract of Presentation

This presentation reviews previous work and reports on recent progress in the author's ongoing effort to quantify the effects of shielding and interference between pairs of buildings located in proximity in a variety of geometric configurations and boundary-layer wind flows. Recent developments in numerical analytical techniques and expert systems have made neural network analysis available as a useful tool in the investigation of this problem. Analysis using neural networks allows the quantification of variables over a continuous range of values, whereas results have previously been limited to the identification of qualitative trends or to the examination of narrowly specific sets of configurations from parametric wind-tunnel studies. In earlier work, the author conducted a program of wind-tunnel testing, collected wind-tunnel data from a variety of other published and unpublished sources, and applied neural network methodology to the analysis of these data describing shielding and interference behavior between two identical simple rectangular prismatic models. The results were plotted in terms of the newly-defined Interference Index vs. Normalized Separation Distance. The most recent research compares the results of the previous neural network analysis to case study data from commercial consulting studies. The case study data are compiled from proprietary consulting reports which have been made available to the author by three major commercial wind tunnel consultants. Analysis of the case study data shows excellent agreement both with the neural network data and among the different wind tunnels, thus verifying the reliability of the neural network in giving quantitative predictions of interference behavior over a broad range of configurations, despite the paucity of available experimental data.

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References

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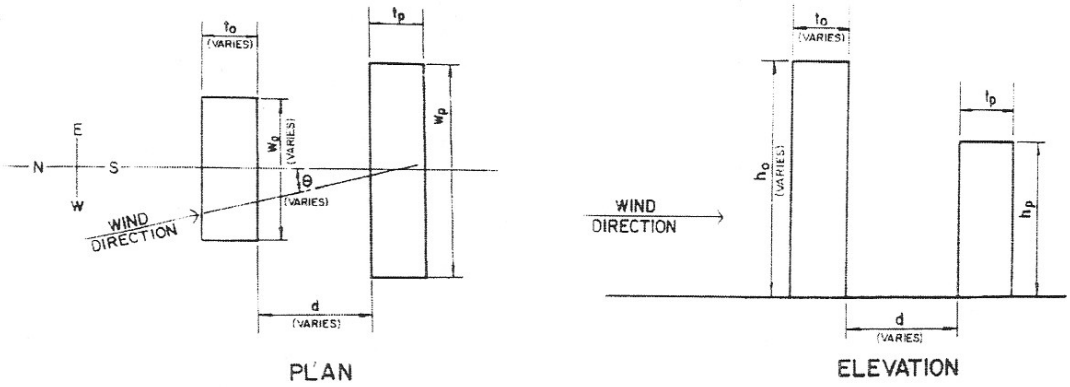
1. Initial Study



Test Configuration and Parameters

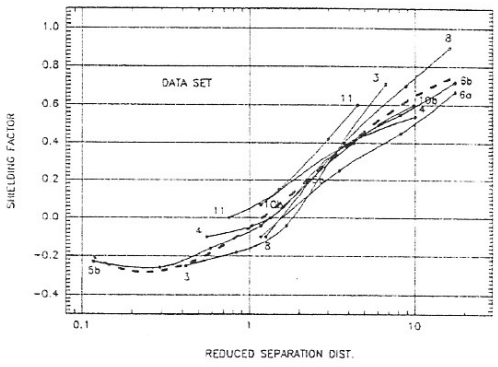
[References: English and Durgin, 1981; English, 1985; English, 1987.]

2. Experimental Data from Other Sources

TABLE 1. DATA SOURCES AND PARAMETERS

REFERENCE NUMBER/ DATA SET	AUTHOR(S)	NUMBER OF DATA POINTS	MODEL ASPECT RATIO	POWER LAW INDEX	TURBULENCE INTENSITY AT TOP OF MODEL
3	English	5	.67	.265	12%
4	Bailey	5	9	.15	10%
5a	Blessman, Riera	5	6	"uniform"	6%
5b	Blessman, Riera	5	6	.34	10%
6/6a	Melbourne, Sharp	4	6	.25	7%
6/6b	Melbourne, Sharp	4	6	.45	14%
7	Ruscheweyh	1	2	.2	
8	Saunders, Melbourne	4	4	.13	4%
9	Sykes	1	4	.19	
10a	Taniike, Inaoke	4	4.5	.14	0
10b	Taniike	3	4.5	.25	13%
11	Zambrano, Peterka	4	2	.26	10%
12	Pathak, Ahuja, Mir	2	8	.13	10%
13	Sakamoto, Haniu	8	3	low	3%
14	Yahyai et al	9	5	.10	4%

Data Sources and Parameters



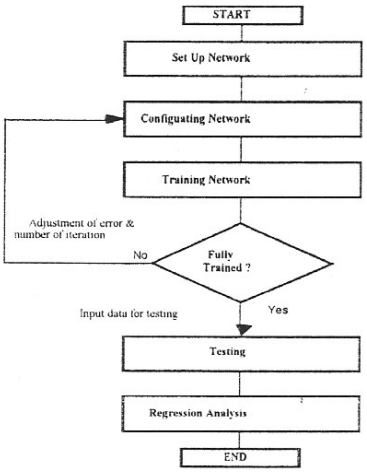
Shielding Factor vs. Separation Distance with Regression Analysis

[References: English, 1990; English, 1993.]

Interference Index and Neural Network Study

$$\text{Interference Index (II)} = \left\{ \begin{array}{c} \text{Interference Factor or} \\ \text{Shielding Factor or} \\ \text{Buffeting Factor} \end{array} \right\} - 1.0$$

$$\text{Normalized Separation Distance (NSD)} = \frac{d(h+w)}{2hw}$$



Flow diagram for the training and testing of a neural network.

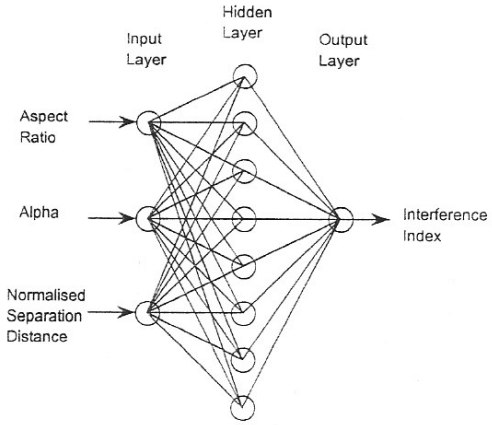
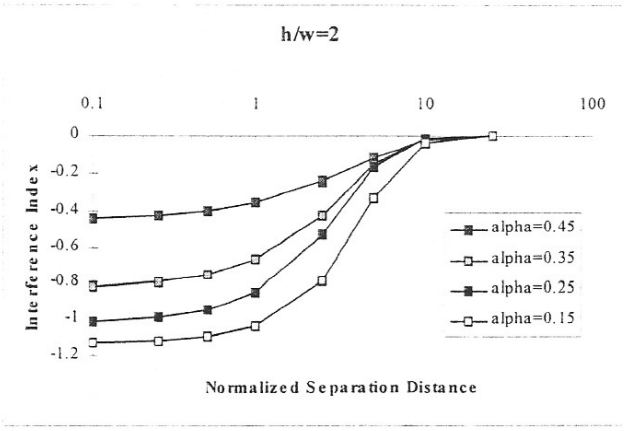


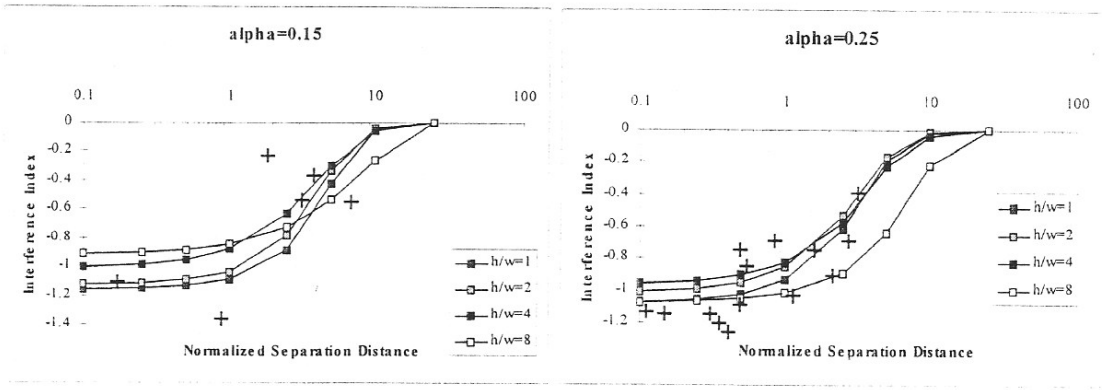
Diagram of the neural network showing the three dimensionless input neurons, the eight "hidden" neurons, and the single dimensionless output neuron.



Neural Network-Predicted Interference Index vs Normalized Separation Distance for a Given Aspect Ratio h/w and Varying Power-Law Exponent Alpha

[References: English and Fricke, 1999; Fricke and English, 1996.]

Comparison to Case Study Data



Comparison of Case Study Data to Neural Network Prediction – Preliminary Results