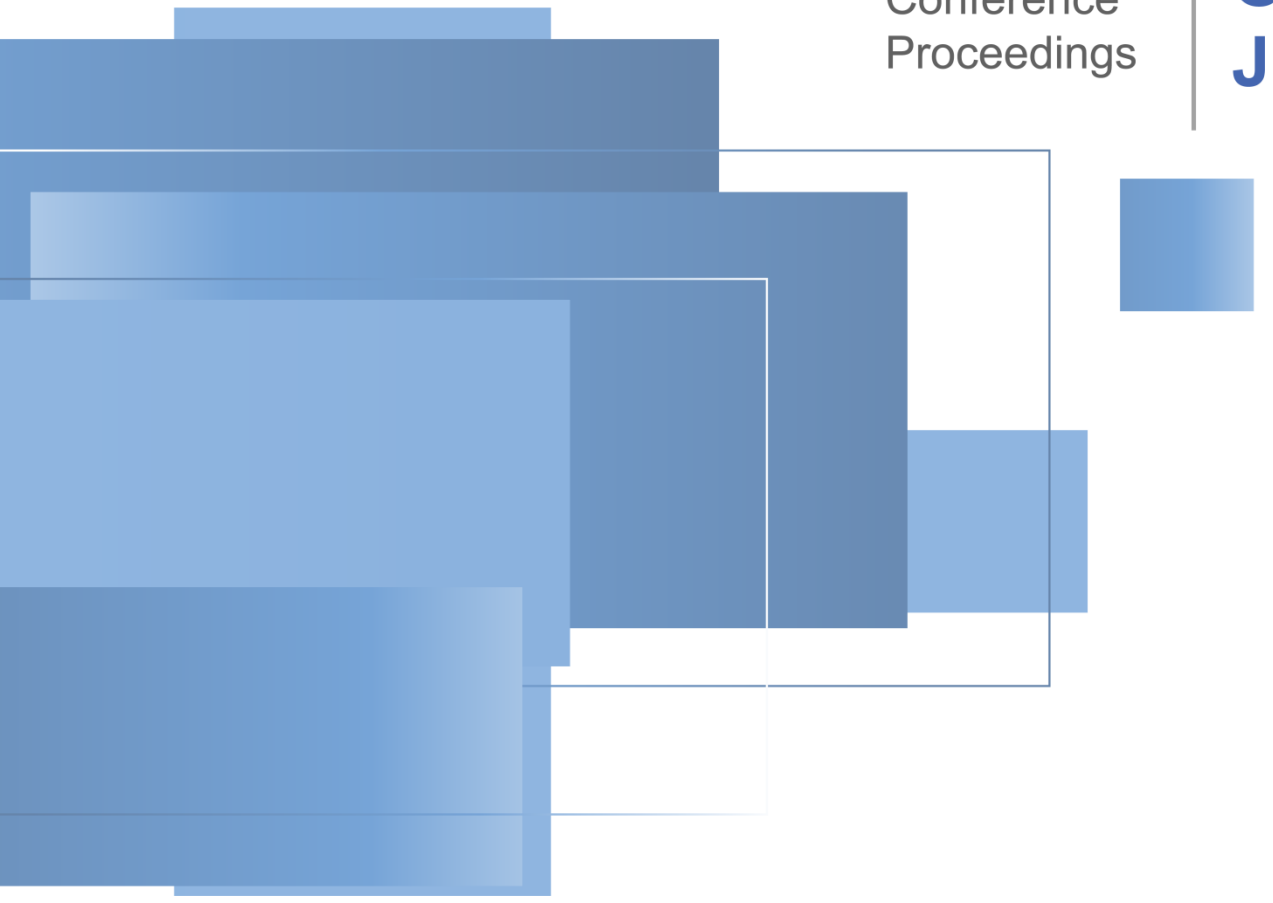
Conference Proceedings

OSAKA JAPAN



ACENS

Asian Conference on Engineering and Natural Sciences

ISFAS

The International Symposium on Fundamental and Applied Sciences

Conference Proceedings

February 06-08, 2018

Osaka, Japan

ACENS

Asian Conference on Engineering and Natural Sciences

ISFAS

International Symposium on Fundamental and Applied Sciences

Civil Engineering (1)

Wednesday, February 07, 2018 15:00-16:30 Room B

Session Chair: *Prof. Yit-Jin Chen*

ACENS-0099

Application of Ensemble Learning Algorithm for Ground Vibration Prediction

Yit-Jin Chen | *Chung Yuan Christian University*
Chih-Hao Liu | *Chung Yuan Christian University*
Chi-Jane Chen | *National Taiwan Ocean University*
Chi-Jim Chen | *Carnegie-Mellon University*

ACENS-0161

Disaster Waste Management Countermeasure Proposals for Regional Partnership against Nankai Trough Earthquake and Tsunami Disasters

Akifumi Kobashi | *Kansai University*
Keiichi Kitazume | *Kansai University*

ACENS-0177

Development of a Seismic Risk Assessment System for Hospitals in Taiwan

Chi-Hao Lin | *National Center for Research on Earthquake Engineering*
Cheng-Tao Yang | *National Center for Research on Earthquake Engineering*
Kuo-Ching Chen | *National Taiwan University*

ACENS-0189

Study on the Evacuation Time of High-Rise Buildings in Thailand by Simulation Model Method

Panit Supasiriluk | *Dhurakij Pundit University*
Aumnad Phdungsilp | *Dhurakij Pundit University*

ACENS-0099
Application of Ensemble Learning Algorithm for Ground Vibration Prediction

Yit-Jin Chen[a], Chih-Hao Liu[b], Chi-Jane Chen[c], Chi-Jim Chen[d]

[a,b] Department of Civil Engineering, Chung Yuan Christian University, Taiwan

[c] Department of Computer Science and Engineering, National Taiwan Ocean University, Keelung, Taiwan

[d] Information Networking Institute, Carnegie-Mellon University, Pittsburgh, USA

E-mail: yjc@cycu.edu.tw [a], g10372004@cycu.org.tw [b], 00457211@mail.ntou.edu.tw [c], jc60516@gmail.com[d]

1. Background

To explore machine learning method for ground vibration prediction, various ensemble learning algorithms are used to predict the vibrations induced by Taiwan high-speed trains on bridge structures with shallow and deep foundations. Field-measured data are used to examine the feasibility of these machine learning methods.

2. Methods

This paper collects a wide variety of field-measured ground vibration data to characterize the ground vibration behavior. The main factors that affect the overall vibration level are established based on the analysis of measurement results. These factors are train speed, structure type, foundation size, geological condition, ground shear wave velocity, measurement distance, vibration frequency, background vibration, and attenuation coefficient. Initially, single algorithm method, including support vector machine (SVM), artificial neural network (ANN), and random forest model (RFM) are used to predict vibration levels, then booting ensemble learning algorithm are adopted to improve the performance of prediction. The prediction quality is expressed by accuracy rate.

3. Results

Analytical results for the single learning methods and ensemble learning algorithms are presented in Table 1 for shallow and deep foundations. It can be seen the prediction results are reasonably well and can be reached to 80% of accuracy rate. In addition, the booting ensemble learning algorithm has better prediction accuracy rate than single learning methods, including ANN, RFM and SVM. These results are discussed in detail.

Table 1 Analysis results for shallow and deep foundations

(a) shallow foundation

	Overall frequency range			
	Method	ANN	RFM	SVM
Accuracy rate (%)	Single algorithm	67	73	77
	Boosting ensemble learning	70	75	81

	Low frequency range			
	Method	ANN	RFM	SVM
Accuracy rate (%)	Single algorithm	52	58	62
	Boosting ensemble learning	56	62	68

	Middle frequency range			
	Method	ANN	RFM	SVM
Accuracy rate (%)	Single algorithms	69	78	78
	Boosting ensemble learning	70	81	82

	High frequency range			
	Method	ANN	RFM	SVM
Accuracy rate (%)	Single algorithms	71	69	75
	Boosting ensemble learning	74	72	78

(b) deep foundation

	Overall frequency range			
	Method	ANN	RFM	SVM
Accuracy rate (%)	Single algorithm	54	66	63
	Boosting ensemble learning	56	72	66

	Low frequency range			
	Method	ANN	RFM	SVM
Accuracy rate (%)	Single algorithm	59	58	63
	Boosting ensemble learning	62	59	65

	Middle frequency range			
	Method	ANN	RFM	SVM
Accuracy rate (%)	Single algorithms	54	59	59
	Boosting ensemble learning	55	64	61

	High frequency range			
	Method	ANN	RFM	SVM
Accuracy rate (%)	Single algorithms	60	67	72
	Boosting ensemble learning	62	73	74

Keywords: Vibration, high-speed trains, ensemble learning algorithm

4. References

Breiman, L. & Cutler, A. (2001). Random forests, Machine Learning, 45(1), 5-32.

Chen, Y. J., Chang, S. M. & Han, C. K., (2010). Evaluation of ground vibration induced by high-speed trains on embankments, Noise Control Engineering Journal, 58(1), 43-53.

Chen, Y. J., Chen, C. J. & Shen, Y. J. (2015). Development of automatic prediction model for ground vibration using support vector machine, Journal of Vibroengineering, 17, 2535-2546.

Chen, Y. J., Chen, C. J. & Shen, Y. J. (2016). Evaluation of machine learning methods for ground vibration prediction model induced by high-speed railway, Journal of Vibration Engineering & Technologies, 4, 283-290.

Cortes, C. & Vapnik, V. (1995). Support vector networks, Machine Learning, Vol. 20, 273–297.