Dr Pedro Martinez-Vazquez BE, MSc, PhD

Design Tutor
Convenor of MSc Programme in Civil Engineering

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About

Dr Martinez-Vazquez received his PhD from the National University of Mexico (UNAM) in 2006. He moved to the UK in 2007 following an invitation from an industrial firm which specialises in wind tunnel studies. In 2008 he was appointed Research Fellow by the School of Engineering at The University of Birmingham and in 2011 he undertook a lectureship at The University of Liverpool. In 2012 he returned to Birmingham for his current position as Design Tutor.

Dr Martinez-Vazquez has long experience in the construction industry. Previous to his PhD studies he participated in the design and supervision of over 50 structures located in South America and the United States. He is familiarised with building codes and engineering practices from Europe and overseas.

He has published 22 papers. His research interests are varied but include structural dynamics, fluid dynamics, wind-tunnel techniques, computational modelling, artificial intelligence, and image recognition techniques. He is also keen to undertake research in other fields of science such as agriculture, biomechanics, teaching and education.

He is graduate member of the IStructE and has recently obtained a Certificated in Higher Education.

Qualifications

- PhD, Universidad Nacional Autónoma de México, 2006
- MSc, Universidad Nacional Autónoma de México, 2002
- BE, Universidad Nacional Autónoma de México, 1994
- Graduate Member, Institution of Structural Engineers, 2012
- Postgraduate Certificate in Learning and Teaching in Higher Education, 2012

Teaching

Dr Martinez-Vazquez teaches all levels of Civil Engineering. The modules he is currently involved are

- Construction Design and professional Skills B
- Engineering Design
- Structural Engineering Design
- Civil Engineering Design Project
- Civil Engineering Research Project
- Engineering Structural Dynamics.
- Foundation Engineering

Postgraduate supervision

Dr Martinez-Vazquez looks forward to supervise PhD research in the following areas:

Wind Engineering

- Estimation of static and dynamic wind loading
- Wind simulation
- Wind tunnel experiments
- **Windborne debris (PDF 360KB) (/Documents/college-eps/civil/staff/martinez-vazquez/windborne-debris-risk-of-damage.pdf)**

Structural Engineering

- Dynamic behaviour of civil engineering structures
- Nanomaterials for improving structural response of structures

Computational Methods

- Artificial Neural Networks
- Pattern Recognition

- Fuzzy Logic

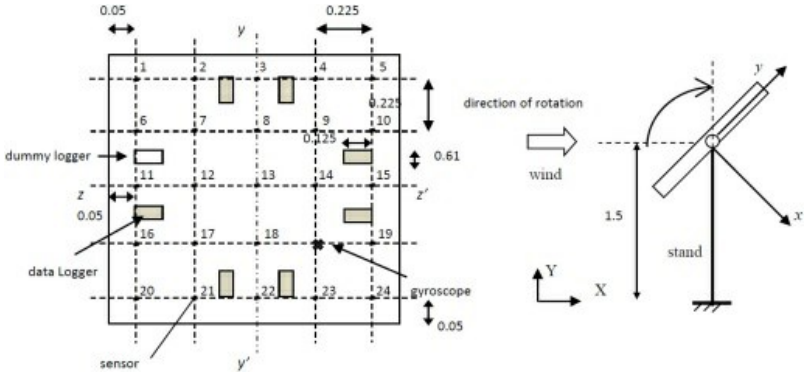
Others

- Dynamic effects on plants and trees induced by wind actions
- Numerical modelling of the human body
- Learning and teaching techniques

Research

The following are examples of past and current research undertaken by Dr Martinez-Vazquez:

The Flight of Windborne Debris - An Experimental, Analytical and Numerical Investigation



a) Test-sheet (front view)

b) Test-sheet on bearings (lateral view)

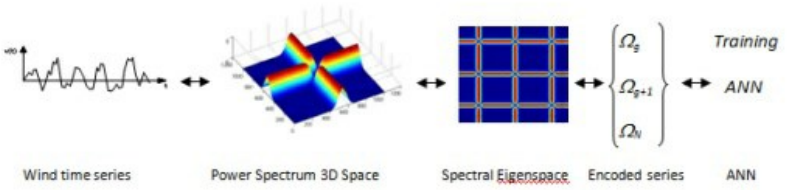
The aerodynamics of flat square plates were investigated by embedding a number of pressure sensors and portable data loggers within the thickness of plates of different characteristics. This technique allowed for the first time to observe the time variation of surface pressures on moving plates. A number of static and autorotational tests undertaken revealed the existence of complex flow structures that cannot be predicted by using standard experimental techniques. In addition, this investigation helped to correlate the pressure and flow fields on rotating plates which up to then had been studied separately.

Design Spectra for Wind Loading

Design spectra are normally applied in Seismic Engineering where it is assumed that the inertial forces induced by the horizontal accelerations acting at base of the structure are fully correlated. In the case of wind loading the amount of energy imparted by the wind to the structural system can be estimated for point-like structures as well as for large areas by considering suitable spatial correlation laws. In addition the use of generalised techniques allows considering the dynamic response of single oscillators whose ensemble response constitutes a design spectrum which in turn can be used to carry out modal analyses. Unlike similar spectral approaches design spectra would not restricted to cases in which the total response is mainly given by the fundamental mode of vibration but these would be applicable to the analysis of multiple degree of freedom systems where the contribution of higher order modes to the total dynamic response is important.

Wind Field Reproduction based on ANN and Conditional Simulation

Image recognition techniques (IR) allow the representation of one-dimensional wind time series as two-dimensional plots. This can be achieved by projecting the components of a one dimensional data series into a two dimensional space. The numerical version of several RPs can be assembled to form a subspace here referred to as *eigen-space* since it follows an eigen-value analysis that allows the redefinition of the data series in terms of short dimension vectors (Ω). IR allows the reconstruction of RPs based on their associated vector Ω. The correspondence RP-Ω can be mapped using an artificial neural network (ANN). The prediction of encoded time series through ANN permits their reconstruction in time domain because the process is reversible. ANN evolved from artificial intelligence to constitute a relatively modern tool with the objective of simulating the natural process of human learning.



The process shown in this figure was applied to identify the characteristics of wind at specific locations which were then used as reference points to apply the algorithm *Conditional Simulation*. In this was an ensemble of wind time series were generated to constitute a correlated wind field.

Predicting Wheat Lodging at Large Scales

The motion of a series of idealised wheat plants in the time domain subject to the application of a wind induced force were examined. A stochastic process representing the wind loading at different points over an imaginary field of wheat was generated. The plants were then modelled as damped harmonic oscillators and the wind induced response compared to the resistance offered by the root/soil and the plant stem. A comparison with a previous approximate method was also undertaken and a simple way to transform the approximate solutions to the full solution outlined here was provided. This computational method provides an alternative approach enabling plant failure over large populations to be predicted.

Publications

Journal Papers

1. Martinez-Vazquez P., Rodriguez-Cuevas N., 2007. *Wind field reproduction using neural networks and conditional simulation*. Journal of Structural Engineering, 29(7), 1442-1449.
2. Martinez-Vazquez P., Rodriguez-Cuevas, 2007. N. *Dynamic response of A MDOF structure subjected to conditional simulation of wind time series*. Publicaciones IIUNAM: SID 654.
3. Martinez-Vazquez P., Baker C.J., Sterling M., Quinn A.D., Richards P.J., 2009. *Aerodynamic forces on fixed and rotating plates*. Wind&Structures, 13(2), 127-144.
4. Kakimpa B., Hargreaves D.M., Owen J.S., Martinez-Vazquez P., Baker C. J., Sterling M., Quinn A. D., 2009. *CFD modelling of fee-flight and autorotation of plate*

type debris. Wind&Structures, 13(2), 169-189.

5. Martinez-Vazquez P., Sterling M., Baker C.J., Quinn A.D., Richards P.J., 2010. *Autorotation of square plates, with application to windborne debris*. Wind&Structures. 14(2), 167-186.
6. Martinez-Vazquez P., Sterling M., 2011. *Predicting wheat lodging at large scales*. Biosystems Engineering, 109(4), 326-337.
7. Martinez-Vazquez P., Kakimpa, B., Sterling M., Baker C.J., Quinn A.D., Richards, P.J. Owen, J.S., 2011. *Pressure field of a rotating square plate*. Wind&Structures. *In Press*.

Conference Papers

1. Martinez-Vazquez P., Rodriguez-Cuevas N., 2004. *Wind Time series generation, using Artificial Neural Networks*. XIV Mexican Congress of Structural Engineering.
2. Martinez-Vazquez P., 2005. *Application of Neural Networks to reproduce the structural response of plane frames submitted to simulated wind loading.* Newsletters of the Wind Engineering Society (WES), 7(4), 9-14.
3. Martinez-Vazquez P., Rodriguez-Cuevas N., Baker C.J., Chan A., 2006. *Response of MDOF structures, using ANN*. 4th International Symposium in Computational Wind Engineering (CWE2006), Yokohama, Japan, July 16-19.
4. Rodriguez-Cuevas N., Martinez-Vazquez P., Marquez-Dominguez S., 2006. *Dynamic interaction between turbulent wind and a slender tower*. XV Mexican Congress of Structural Engineering.
5. Rodriguez-Cuevas N., Martinez-Vazquez P., 2007. *Seismic Analysis of the foundation of an electric plant*. XVI Mexican Congress of Structural Engineering.
6. Martinez-Vazquez P., 2008. *Simulation of across-wind forces on circular cylinders: a comparison with the ESDU code.* 8th UK Congress in Wind Engineering, University of Guilford, UK, July 14-16.
7. Martinez-Vazquez P., 2008. *Application of image recognition techniques to the study of wind power spectra.* 8th UK Congress in Wind Engineering, University of Guilford, UK, July 14-16.
8. Martinez-Vazquez P., Kakimpa B., Hargreaves D.M., Baker, C.J., Sterling, M., Quinn, A.D., Owen, J.S., 2009. *Predicting the flight of wind borne sheet type debris - an analytical and computational approach.* 17th UK Conference on Computational Mechanics, Nottingham, April 6-9.
9. Martinez-Vazquez P., Baker C.J., Sterling M., Quinn A.D., 2009. *The flight of wind borne debris: an experimental analytical and numerical investigation: Part I (Analytical Model)*, 5th European and African Conference on Wind Engineering (EACWE5), Florence, July 19-23.
10. Martinez-Vazquez P., Baker C.J., Sterling M., Quinn A.D., Richards P.J., 2009. *The flight of wind borne debris: an experimental analytical and numerical investigation. Part II (Experimental work).* 7th Asia-Pacific Conference on Wind Engineering, Taipei, Nov 10-12.
11. Martinez-Vazquez P., Baker C.J, Sterling M., Quinn A.D., 2010. *A Parametric study related to autorotation*, 9th UK Conference on Wind Engineering, Bristol, September 20-22.
12. Martinez-Vazquez P., Baker C.J, Sterling M., Quinn A.D., 2010. *Estimation of free flight trajectories of wind-borne debris using eigenfaces for recognition,* 6th International Symposium on Environmental Effects on Buildings and People: Actions, Influences, Interactions, Discomfort (EEBP VI), Tomaszowice, October 11-13.
13. Martinez-Vazquez P., Sterling M., Rodriguez-Cuevas N., 2010. *Design spectra for wind loading*, 6th International Symposium on Environmental Effects on Buildings and People: Actions, Influences, Interactions, Discomfort (EEBP VI), Tomaszowice, October 11-13.
14. Martinez-Vazquez P., Baker C.J., Sterling M., Quinn A.D., Richards P.J., 2011. *Non-averaged wind forces acting on a rotating plate*, 13 International Conference in Wind Engineering (ICWE13), Amsterdam, July 10-15.
15. Martinez-Vazquez P., Sterling M., 2011, *Dynamic response of wheat plants submitted to wind loading*, 13 International Conference in Wind Engineering (ICWE13), Amsterdam, July 10-15.