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RANDOM PROCESS PEAKS PREDICTION: A LITERATURE OVERVIEW

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Abstract

The prediction of the maximum or minimum peaks of a random process in the fields of civil and mechanical engineering is a hot topic for the scientific literature. It is known that the maximum of a random process depends on the process length. For this reason, a probabilistic approach is necessary to estimate a reliable value from the process. Researchers for specific case of studies proposed several analytical models to predict maxima of a random process. Mostly, they are grouped on two families, models for Gaussian processes and models for non-Gaussian processes. Each model was computed and calibrated based on a specific experimental campaign for a specific case of study. This makes difficult to select the best model for every application. In addition, codes and standards neglect this topic and one might happen to make the error to assume the maximum value as the statistical maximum of the random process. Commonly, in the field of the structural engineering, peaks of a wind induced, or wind-induced flow acceleration time histories are estimated following the probabilistic approach of Cook and Mayne. However, from 1950 to today hundreds different probabilistic approach was given by literature. The purpose of this paper is to discuss an overview of models grouped by theoretical underlying assumptions.

Keywords: Random processes, Gaussianity, stochastics, peak factors, wind tunnel.

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1. INTRODUCTION

In the field of wind engineering the experimental tests in wind tunnel are the rule to investigate the building aerodynamics. In wind tunnel random processes of pressure are acquired through pressure taps and tubes located on the building surfaces. Generally, the main result that it is estimated is the pressure coefficient that is dimensionless respect to the wind tunnel velocity. In wind tunnel, processes generally are stationary, and the mean value does not depend on the history time length. However, the mean value of the pressure coefficient time history is not the only one parameter that is important for the building structural analyses. In many cases the most important magnitude is the maxima or minima peak of the random process that are closely important to design structure very sensitive to the wind action differently than structure sensitive to the seismic action [1]. This is a hot topic for the scientific literature in the fields of civil and mechanical engineering. Unfortunately, the absolute maximum (or minimum) of a random process depends on the process time length. Usually, a probabilistic approach is used to estimate a reliable maximum (or minimum) value from the process and several analytical models were proposed by the scientific literature. Mostly, they are grouped on two families, models for Gaussian processes and models for non-Gaussian processes. Each model was computed and calibrated based on a specific experimental campaign for a specific case of study and this makes difficult to select the best model for every application. The purpose of this paper is to discuss an overview of models grouped by theoretical underlying assumptions.

2. LITTERATURE OVERVIEW

2.1 From Cartwright and Longuet-Higgin, 1956 to Vanmarcke, 1975, through Davenport, 1964.

One of the first analytical model computed to predict extreme peaks used the field of wind engineering is given by [2] (more recently developed by [3]) and it was computed to predict the peaks of the sea waves. It is based on the assumption that the process is stationery and Gaussian and that the maxima follow a Rayleigh distribution. Starting from this model, Davenport [4], developed the most used model to predict the peak factors of Gaussian processes. It was based on the assumption that largest extreme values of a Gaussian normalized and standardized process, asymptotically follow a Gumbel distribution. This model still today to be the base of all analytical models to predict extreme peaks. About ten year later, [5] accounting for the dependence among the crossing events through a shape factor calculated from the process spectral moments. Unlike Davenport's peak factor, Vanmarcke's [5], peak factor can be applicable to narrow-band response processes while taking consideration of the spectral bandwidth effects [6,7]. Several studies, also recently, have proposed method to extend the [4] and its subsequent updates to non-Gaussian processes, as for example [8] that proposed the extended Davenport peak factor (EDPF). This method relates the descriptors of the resultant, the parameters of the distribution function of the peaks, and the probability of not exceeding a given threshold, however the method seems to have be limited and poorly generalizable.

2.2 From Cook and Mayne 1979 to Harris, 2005

From 1979 to today, the studies published by Cook are a milestone because they proposed a working approach based on a fully probabilistic assessment (i.e. the Gumbel distribution of extremes) to estimate wind loads for the equivalent static design of structures [9, 10]. This approach was born with the precise intent to fill a gap in codes and consequentially it is very sample. This approach was proposed in [11] and refined in [12] in which the previous approach is extended from the original first-order form, to admit multiple-order corrections through a Monte-Carlo method that replaces the former integral method. This method is still very often used in the field of structural wind engineering [13]. The design fractile of extreme wind load coefficient distribution for a 50-year return period is recommended equal to 79%. According to [14] this value can be increased to 93% to estimate the extremes of the wind velocity, based on the multi-order technique applied by authors.

In Cook, 1982 [15], Cook proposed the peak-factor approach that aims to exceed the limits of the fully probabilistic approach, given by [11], for which fluctuations of load are due to corresponding gusts in the approach flow. These numerical approaches will feed in the designer's guide to wind loading of building structures, Parts 1 and 2 [16, 17]. These methods were based on the assumption that the process is stationary, and this hypothesis is one of the weaknesses on which [18] worked. It has given an extension of the methods given by Cook, to full-scale wind-load measurements where the flow is intrinsically non-stationary. Harris, 1982 [19] provides the [15] theoretical background fully probabilistic approach (i.e. based on the Gumbel distribution of the extremes). It proposed the elimination of the Monte-Carlo corrections, the will be widely used by researchers, as for example [20] that have used this method to estimates peak wind pressures on three-dimensional rectangular buildings with different aspect and side ratios in different atmospheric boundary layers.

Harris will develop the traditional Gumbel extreme value method in [21] through a fitting procedure using weighted least squares that improves set of plotting positions based on the mean values of the order statistics and subsequently, through a direct method given by [22]. This last method does not require Monte-Carlo simulations or the assumption that extreme pressures conform to the ultimate Fisher–Tippett Type I asymptote.

2.3 From Holmes and Moriarty,1999 to Torrielli et al, 2016 through modification of the Cook and Mayne 1979 model

Several approaches have discussed modification and updates of the [11, 12] approach focused on the probability trend of the extremes in a random process.

The important issue of the extreme peaks of the wind velocity discussed by [23] have inspired [24-26] that have applied the Annual Rate of Independent Events (ARIE) method values, though its modification, to estimate the extremes wind velocity, subsequently discussed for clarification by [27, 28] and [29]. The modification consists on using the Hybrid Weibull model given by [30], to describe the parent distribution of the wind velocity simulations.

Holmes and Moriarty, 1999 [31] proposed the generalized Pareto distribution (GPD) and its application to the statistical analysis of extreme wind speeds. It concluded that generalized extreme value distribution (GEVD) can be used to determine the appropriate value of shape factor, k, for use in the GEVD. In 2001, [32] and [33] not recommend this approach and discussed the conclusion given by [31], because this method is closely threshold dependent and so not applicable for a process with a Weibull parents. However, [34] confirm the goodness of this method using many and very long acquisitions of pressure series in wind tunnel experiments on a low-rise building as similarly it was done by [35].

Similarly, the Peaks-Over-Threshold (POT) is also affected by limits given by the practical applications of POT method as it was shown by [36]. An and Pandey, 2005 [36] shown that this model fail because the acute threshold sensitivity of wind speed estimates, which can be attributed to erratic variation of model and sampling errors with selected threshold values. In addition, [36], based on results given by [37], proposed a modification based on the assignment of an exponential prior on preconditioned data that is augmented with additional sample information in an optimal sense through the principle of Minimum Cross-Entropy (Cross-

Ent). An update of the POT method was proposed by [38] through a declustering of process to extract independent peaks over a given threshold. for POT method and [39].

2.4 From Grigoriu 1984 to Kwon and Kareem, 2011, though Winterstein models.

Meanwhile, [40] discussed the mean up-crossing rates for Gaussian and non-Gaussian processes, laying the groundwork for future analytical models that aim to predict extremes of non-Gaussian processes, as for example the analytical models given by [41, 42] and the chaos polynomial theory of which some applications are discussed by[43, 44]. This approach was largely used by researcher through application, as for example by [45, 46] or to develop new models. Winterstein proposed a nonlinear vibration approach using the Moment-based Hermite model to predict extremes of a random vibration, subsequently applied in [47] on a statistical analysis of tension-leg platforms. Kareem and Zhao 1994 [48] developed the model applied by [47]. The given improvement consists of an equivalent statistical quadratization method that permits to derive the response probability density function, crossing rates, and peak value distribution based on the first four cumulants. The method was known as revised Hermite model [49, 50].

This method was developed by [51] using a limited number of statistical moments. Subsequently the model given by [47] and based on the an equivalent statistical quadratization method was developed using a cubicization in [52]. Depending upon the nature of the nonlinearity, the quadratization and the cubicization method may be employed to approximate the process by a quadratic or cubic polynomial. It permits to preserve the nonlinearity using a Volterra functional series approach to attain the response transfer functions. The models is known as modified Hermite model [49]. The distribution of the largest peak values is assumed as a Gumbel distribution, which implies a Weibull distribution for the local peaks of the pressure coefficients.

Yang et al, 2013 [53] proposed a modification of modified Hermite model given by [52] and [54] has given an application. The modification proposed by [53] consists on a numerically inversion of the relationship between skewness, kurtosis and the Hermite model shape parameters and on an approximate solution to improve the accuracy of the Hermite model.

The peak factor for non-Gaussian processes given by [48], was used by [55] to simulate non-Gaussian processes in terms of correlation-distortion methods and application of higher-order spectral analysis. Similarly, the model given by [48] was used to Kareem et al 1998, that developed a technique to model the contribution of the quadratic drag term containing the square of the fluctuating velocity component through the development of a non-Gaussian gust loading factor via moment-based Hermite transformation. This model was based on the concept of a translation process given by [40], moment-based Hermite model given by [42], and the framework of Gaussian peak factor given by [4]. Thirteen years later, after [51] updates, [49] completed the model and it gives the variance of the estimates in standard deviation for the peak factor of non-Gaussian processes on the basis of a moment-based Hermite model [41, 42].

Later, [56] proposed the "L-Hermite" model, an alternative cubic transformation calibrated by the response "L-moments" rather than its ordinary statistical moments. However, this method seems valid only for specific cases of study as for example marine structures in shallow waters [57], because it cannot convey sufficient information to accurately estimate extreme response statistics. The Winterstein, 1988 [42] and 2000 [51] models were developed by [58] to improve their accuracy and simplify their application to measured data in the case of wind pressure data. In particular, [58] proposed a closed form approximate relationship between the skewness and kurtosis and the Hermite models shape parameters. Based on its results, it suggests that the bandwidth parameter related to the 4th-order spectrum moment should not be introduced.

Several papers proposed new models based on the moment-based Hermite polynomial model as for example the model proposed by [59] that modify the Hermite polynomial method to obtain accurate approximation of extremes of processes with high skewness and Gaussian kurtosis. Many models promoted the Hermite polynomial model to transform non-Gaussian data into a Gaussian process. Huang et al 2016 [60, 61] results suggest that Hermite moment-based should be adopted in the peak value estimation for wind pressures only when the skewness and kurtosis of a process are sufficient to capture its non-Gaussian properties. However, Cook, 2016 [62] refuted these results applying the Bootstrapping methods (EVA) [63].

Liu et al, 2016 and 2017 [64, 65] proposed a model that aims to solve the problem given by the positive and negative probability distribution tails that affect skewness and kurtosis are statistical moments. To improve the accuracy of the moment-based model approach, it derived a new moment-based translation model by defining a modified probability density function that is symmetric around the median of the original non-Gaussian process. Accordingly, the distributions of maximum and minimum are addressed separately using newly defined two sets of statistical moments with zero skewness. Rizzo et al, 2018 [50] have shown that for strongly non-Gaussian processes this method is not particularly accurate. Rizzo et al, 2018 [50] have given an application of the modified Hermite models on Hyperbolic paraboloid roofs [66-70].

2.5 From Sadek and Simiu, 2002 to Huang M. F. et al 2016

The theory proposed by [71] was innovative because it proposed an automated mapping procedure to estimate the peak distribution of wind-induced non-Gaussian internal forces on low-rise buildings by using a database-assisted design software. This mapping procedure requires identifying an analytical marginal probability distribution for the time series of interest through numerical fitting of the distribution parameters. However, the Sadek and Simiu, 2002 [71] method has been applied only to non-Gaussian processes with an underlying marginal gamma distribution [50]. The result obtained is that a gamma distribution (i.e. three-parameter Gamma distribution) is appropriate for estimating the peaks corresponding to the longer tail of the time series' histograms and a normal distribution corresponding to the shorter tail of the time series' histograms, that are the same conclusions shown by [72]. The distribution of the peaks is then estimated by using the standard translation processes approach given by [40] and developed in [73]. It is found that the peak distribution can be represented by the Gumbel distribution. The estimation obtained through this approach is based on the entire time series and consequently it is more reliable than estimation based only on observed peaks. However, the three-parameter Gamma distribution specific relationship between skewness and kurtosis holds. Once the combinations of skewness and kurtosis of actual samples deviate far away from the relationship, remarkable fitting errors will be incurred [74]. Ma and Xu, 2017 [74], proposed an update of the Gamma method through the Johnson transformation to solve the fitting error. This method depends on the maximum likelihood (MML) [75] to estimate the Johnson transformation parameters.

Using the [71] procedure, [76, 77], estimated the extreme peak pressure distribution based on wind-induced time history pressure data recorded in a wind tunnel and determined the design pressure and load coefficients at any selected probability level of non-exceedance for reliability-based structural design. Recently, Yang et al, 2019 [75] proposed an update using a three-parameter Gamma distribution through formulations for estimating sampling errors of the first four statistical moments.

Based on the [71] results, [6] proposed the Gamma peak factor and it have applied this approach to estimate the wind-induced vibration on tall buildings. This study is one of the few studies that worked on accelerations, discussed in this paper, differently than pressure or wind velocity. For this reason, this contribute will be carefully discussed in the next sections.

From Sadek and Simiu, 2002 [71], Huang et al 2013 [78] and [79], gives an efficient model known as translated-peak-process method (TPP) for the estimation of the peak distribution, peak factor, and variability of extremes, based on the Weibull distribution and point-to-point mapping procedure. The innovation consists on a modification of the [71] from Gamma to Weibull distribution processes [50] and it is particularly efficient for non-Gaussian process. However, it needs to an elaboration of the measured data to fit a Weibull distribution that take only positive bigger than zero values.

2.6 Analytical models based on the ACER approach

The univariate concept of average conditional exceedance rate (ACER) is a method for estimation of extreme wind speed statistics proposed by [80] and by [81] that have given an extension for estimation of extreme wind speed statistics to the case of bivariate wind speed time series based on the previous research on the Monte Carlo methods for estimating the extreme response of dynamic systems [82, 83]. Naess and Karpa, 2015 [81] calibrated and tested the bivariate method for simultaneous wind speed measurements from two separate locations. The univariate approach is based on two separate components: the first component has the capability to accurately capture and display the effect of statistical dependence in the data; the second component is then constructed so as to make it possible to incorporate to a certain extent also the subasymptotic part of the data into the estimation of extreme values [80]. The goodness of this analytical method was confirmed by [84] and it was used by the models developed by [85] and [86]. Finally, Chen, 2014 [87] proposed a model that, based on results given by [88], through the curve-fitting and extrapolation of crossing rate, permits the estimation of extreme values distribution using Poisson distribution of crossings.

3. CONCLUSIONS

This paper discusses the most common analytical models to predict peaks (i.e. local and absolute) from random processes. Models are grouped based to milestones and specifically they are grouped in five families: (I) models for Gaussian process; (II) models from Cook school, (III) models based on Grigoriu studies; (IV) models based on the Sadek and Simiu studies and finally, (V) recent models based on the ACER approach. It is not possible to a priori estimate the best model for a specific case of study investigated and all models are valid until proven otherwise.

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REFERENCES

[1] A. Maria Avossa, D. Di Giacinto, P. Malangone and F. Rizzo, Seismic Retrofit Of A Multi-Span Prestressed Concrete Girder Bridge With Friction Pendulum Devices. *Shock and Vibration*, 2018, Article ID 5679480, 2018.

[2] D.E. Cartwright, M.S. Longuet-Higgins. Statistical distribution of the maxima of a random function. *Proceedings of the Royal Society of London*. Series A, Mathematical and Physical Sciences, 237(1209), 212-232, 1956.

[3] S.N. Pillai, Y. Tamura, Generalized peak factor and its application to stationary random processes in wind engineering applications. *Journal of Wind and Engineering and Industrial Aerodyna*mics, 6(1), 1-9, 2009.

[4] A.G. Davenport, Note on the distribution of the largest value of a random function with application to gust loading. *Proceedings of the Institution of Civil Engineering*, 28(2), 187–196, 1964.

[5] E.H. Vanmarcke, Properties of spectral moments with applications to random vibration. *Journal of Engineering Mechanics*, 98(EM2):425-446, 1972.

[6] M. Huang, C. M. Huang, C. M. Chan, L. ChanWen-juan, K. Chung-Siu, Statistical extremes and peak factors in wind-induced vibration of tall buildings. *Journal of Zhejiang University - Science A: Applied Physics and Engineering* 13(1),18-32, 2012.

[7] X. Wang, E.M. Rathje, Influence of Peak Factors on Random Vibration Theory Based Site Response Analysis. 6th International Conference on Earthquake Geotechnical Engineering 1-4 November 2015 Christchurch, New Zealand, 2015.

[8] P. Folgueras, S. Solari, M. Mier-Torrecilla, M. Doblaré, M. Losada, The extended Davenport peak factor as an extreme-value estimation method for linear combinations of correlated non-Gaussian random variables. *Journal of Wind Engineering and Industrial Aerodynamics*, 157, 125-139, 2016.

[9] F. Rizzo, V. Sepe, F. Ricciardelli, A. M. Avossa, Wind pressures on a large span canopy roof. *Wind and Structures and International Journal*, 30(2): 000-000 DOI: https://doi.org/10.12989/was.2020.30.2.000, 2020.

[10] F. Rizzo, V. Sepe, Static loads to simulate dynamic effects of wind on hyperbolic paraboloid roofs with square plan, *Journal of Wind Engineering and Industrial Aerodynamics*, 137, 46-57, 2015.

[11] N. J. Cook, J. R. Mayne, A novel working approach to the assessment of wind loads for equivalent static design. *Journal of Wind Engineering and Industrial Aerodynamics*, 4(2), 149-164.17:29 30/03/2020, 1979.

[12] N.J. Cook, J.R. Mayne, A refined working approach to the assessment of wind loads for equivalent static design, *Journal of Wind Engineering and Industrial Aerodynamics*, 6(1-2), 125-137, 1980.

[13] M. Xia, C.S. Cai, F. Pan, Y. Yu, Estimation of extreme structural response distributions for mean recurrence intervals based on short-term monitoring, *Engineering Structures*, 126, 121-132, 2016.

[14] H. Yi, Y. Tamura, Q. Yang. Technical Papers: Estimation of Extreme Wind Load on Structures and Claddings. *Journal of Engineering Mechanics*,143(9), 2017.

[15] N.J. Cook, Calibration of the quasi-static and peak-factor approaches to the assessment of wind loads against the method of Cook and Mayne. *Journal of Wind Engineering and Industrial Aerodynamics*, 10(3), 315-341, 1982.

[16] N.J. Cook, The designer's guide to wind loading of building structures. Part 1: Background, damage survey, wind data and structural classification. Building Research Establishment, Butterworths, U.K, 1985.

[17] N.J. Cook, The designer's guide to wind loading of building structures. Part 2: Static structures. Building Research Establishment, Butterworths, U.K, 1990).

[18] Hoxey R. P., Richards P. J., Richardson G.M., Robertson A. P., Short J.L., 1996.The folly of using extreme-value methods in full-scale experiments. *Journal of Wind Engineering and Industrial Aerodynamics*, 60, 109-122.

[19] R. I. Harris, An improved method for the prediction of extreme values of wind effects on simple buildings and structures. *Journal of Wind Engineering and Industrial Aerodynamics*, 9(3), 343-379, 1982.

[20] J. Wacker, E.J.M. Plate, Local peak wind pressure coefficients for cuboidal buildings and corresponding pressure gust factors. *Journal of Wind Engineering and Industrial Aerodynamics*, 50, 183-192, 1993.

[21] R.I. Harris, Gumbel re-visited - a new look at extreme value statistics applied to wind speeds. *Journal of Wind Engineering and Industrial Aerodynamics*, 59 (1996) 1-22, 1996.

[22] R. I. Harris, Extreme value analysis of epoch Maxima-convergence, and choice of asymptote. *Journal of Wind Engineering and Industrial Aerodynamics*, 92, 897–918, 2004.

[23] R. I. Harris, A new direct version of the Cook–Mayne method for wind pressure probabilities in temperate storms. *Journal of Wind Engineering and Industrial Aerodynamics*, 93, 581–600, 2005.

[24] A. Torrielli, M. P. Repetto, G. Solari, The annual rate of independent events for the analysis of extreme wind speed. *Journal of Wind Engineering and Industrial Aerodynamics*, 156, 104-114, 2016.

[25] A. Torrielli, M. P. Repetto, G. Solari, Response to the Discussion on The annual rate of independent events for the analysis of extreme wind speed, by R. Ian Harris. *Journal of Wind Engineering and Industrial Aerodynamics*. 164, 179–181, 2017.

[26] A. Torrielli, M. P. Repetto, G. Solari, Discussion Response to the further discussion on The annual rate of independent events for the analysis of extreme wind speed, by N. Cook. *Journal of Wind Engineering and Industrial Aerodynamics*, 174, 464-465, 2018.

[27] R.I. Harris, N.J. Cook, The parent wind speed distribution: Why Weibull? *Journal of Wind and Engineering and Industrial Aerodynamics*,131, 72–87, 2014.

[28] R. I. Harris. Discussion of The annual rate of independent events for the analysis of extreme wind speed By Alessio Torrielli, Maria Pia Repetto and Giovanni Solari. *Journal of Wind Engineering and Industrial Aerodynamics*, 164, 174-178, 2017.

[29] N.J. Cook. Further discussion of The annual rate of independent events for the analysis of extreme wind speed by A. Torrielli, M. P. Repetto and G. Solari. *Journal of Wind Engineering and Industrial Aerodynamics*, 174, 458–463, 2018.

[30] E.S. Takle, J.M. Brown, Note on the use of Weibull statistics to characterize wind speed data. *Journal of Applied Meteorology*, 17,556–559, 1978.

[31] J. D. Holmes, W.W. Moriarty, Application of the generalized Pareto distribution to extreme value analysis in wind engineering. *Journal of Wind Engineering and Industrial Aerodynamics*, 83(1–3),1-10, 1999.

[32] N. J. Cook, R. I. Harris, Discussion on Application of the generalized Pareto distribution to extreme value analysis in wind engineering by Holmes J.D., Moriarty W.W. *Journal of Wind Engineering and Industrial Aerodynamics* 89, 215-224, 2001.

[33] R. I. Harris, Generalized Pareto methods for wind extremes. Useful tool or mathematical mirage? *Journal of Wind Engineering and Industrial Aerodynamics* 93(5), 341-360, 2001.

[34] J.D. Holmes, L.S. Cochran, Probability distributions of extreme pressure coefficients. *Journal of Wind Engineering and Industrial Aerodynamics* 91, 893-901, 2003.

[35] C. Sacré, J.M. Moisselin, M. Sabrea, J.P. Floria, B. Dubuisson, A new statistical approach to extreme wind speeds in France. *Journal of Wind Engineering and Industrial Aerodynamics*, 95, 1415-1423, 2007.

[36] Y. An, M.D. Pandey, Technical note: A comparison of methods of extreme wind speed estimation. *Journal of Wind Engineering and Industrial Aerodynamics*, 93, 535-545, 2005.

[37] M.D. Pandey, An adaptive exponential model for extreme wind speed estimation. *Journal of Wind Engineering and Industrial Aerodynamics*, 90, 839–866, 2002.

[38] J. Ding, X. Chen, Assessment of methods for extreme value analysis of non-Gaussian wind effects with short-term time history samples. *Engineering Structures*, 80, 75-88, 2014.

[39] X. Zhang, X. Chen, Assessing probabilistic wind load effects via a multivariate extreme wind speed model: A unified framework to consider directionality and uncertainty. *Journal of Wind Engineering and Industrial Aerodynamics*, 147, 30-42, 2015.

[40] M. Grigoriu. Crossings of non-Gaussian translation processes. *Journal of Engineering Mechanics*, 110(4), 610-620, 1984.

[41] S. R. Winterstein, Moment-based hermite models of random vibration. Report 219, Department of Structural Engineering, Technical University of Denmark, 1987.

[42] S.R. Winterstein, Nonlinear vibration models for extremes and fatigue. *Journal of Engineering Mechanics*, 114(10), 1772-1790, 1988.

[43] F. Rizzo, L. Caracoglia, Artificial Neural Network model to predict the flutter velocity of suspension bridges. *Computers and Structures*, 233 (2020) 1062362020.

[44] F. Rizzo, F. Ricciardelli, G. Maddaloni, Bonati A., A. Occhiuzzi, Experimental error analysis of dynamic properties for a reduced-scale high-rise building model and implications on full-scale behavior. *Journal of Building Engineering*, 28, 2020.

[45] K. Saranyasoontorn, L. Manuel, Efficient models for wind turbine extreme loads using inverse reliability. *Journal of Wind Engineering and Industrial Aerodynamics*, 92, 789-804, 2004.

[46] J. Song, W. Xu, G. Hu, S. Liang, J. Tan, Non-Gaussian properties and their effects on extreme values of wind pressure on the roof of long-span structures. *Journal of Wind Engineering and Industrial Aerodynamics*, 184, 106-115, 2019.

[47] S.R. Winterstein, T.C. Ude, G. Kleiven, Springing and slow-drift responses: predicted extremes and fatigue vs simulation. Proceedings, Behavior of Offshore Structures at Sea - BOSS-94, MIT, 3, 1-15, 1994.

[48] A. Kareem, J. Zhao, Analysis of non-Gaussian surge response of tension leg platforms under wind loads. *Journal of Offshore Mechanics and Arctic Engineering*, 116(3), 137-144, 1994.

[49] D. Kwon, A. Kareem, Peak Factors for Non-Gaussian Load Effects Revisited. *Journal of Structural Engineering*, 137(12), 1611-1619, 2011.

[50] F. Rizzo, M. Barbato, V. Sepe, Peak factor statistics of wind effects for hyperbolic paraboloid roofs. *Engineering Structures*, 173, 313-330, 2018.

[51] S.R. Winterstein, T. Kashef, Moment-based load and response models with wind engineering applications. *Journal of Solar Energy Engineering*, 122, 122-128, 2000.

[52] M.A. Tognarelli, J. Zhao, K. B. Rao, A. Kareem, Equivalent Statistical Quadratization and Cubicization for Nonlinear Systems. *Journal of Engineering Mechanics*, 123(5), 1772-1790, 1997.

[53] Q. Yang, Y. Tian, Comparison of non-Gaussian peak factor formulae in wind engineering applications. Proceedings of The Eighth Asia-Pacific Conference on Wind Engineering, December 10–14, 2013, Chennai, India, 2013.

[54] L.V. Binh, T. Ishihara, P.V. Phuc, Y. Fujino, A Peak Factor for non-Gaussian Response Analysis of Wind Turbine Tower. *Journal of Wind Engineering and Industrial Aerodynamics*, 96, 2217-2227, 2008.

[55] K.R. Gurley, M.A. Tognarelli, A. Kareem, Analysis and simulation tools for wind engineering. *Probabilistic Engineering Mechanics*, 12(1), 9–31, 1997.

[56] S.R. Winterstein, C.A. MacKenzie, Extremes of nonlinear vibration: comparing models based on moments, l-moments, and maximum entropy. *Journal of Offshore Mechanics and Arctic Engineering*, 135(2):021602, 2012.

[57] L. Sant'Anna Nascimento, L. Sagrilo, G. Ellwanger, Extreme Value Analyses of Dynamic Response Parameters of a Wind Tower Structure Under Short-Term Nonlinear Irregular Seastate. Conference: ASME 2017 36th International Conference on Ocean, Offshore and Arctic EngineeringAt: Trondheim, Norway, 2017.

[58] L. Yang, K. R. Gurley, O. D. Prevatt, Probabilistic modeling of wind pressure on low-rise buildings. *Journal of Wind Engineering and Industrial Aerodynamics*, 114, 18–26, 2013.

[59] M. Choi, B. Sweetman, The Hermite moment model for highly skewed response with application to tension leg platforms. *Journal of Offshore Mechanics and Arctic Engineering*, 132(2), 021602, 2010.

[60] G. Huang, Y. Luo, K. R. Gurley, J. Ding Ying Luo, Revisiting moment-based characterization for wind pressures. Journal of Wind Engineering and Industrial Aerodynamics, 151, 158-168, 2016.

[61] G. Huang, Y. Luo, K. R. Gurley, J. Ding Ying Luo, Response to Revisiting moment-based characterization for wind pressures. *Journal of Wind Engineering and Industrial Aerodynamics*,158,162–163, 2016.

[62] N. J. Cook, Discussion of Revisiting moment-based characterization for wind pressures. *Journal of Wind Engineering and Industrial Aerodynamics*, 158, 155–161, 2016.

[63] N.J. Cook, Calibration of EVA methods for peak-over-threshold wind data using Bootstrapping. *Journal of Wind Engineering and Industrial Aerodynamics*, 120, 91–95, 2013.

[64] M. Liu, X. Chen, Q. Yang, Characteristics of dynamic pressures on a saddle type roof in various boundary layer flows. *Journal of Wind Engineering and Industrial Aerodynamics*, 150, 1–14, 2016.

[65] M. Liu, X. Chen, Q. Yang, Estimation of peak factor of non-Gaussian wind pressures by improved moment-based Hermite model. *Journal of Engineering Mechanics*, 143(7): 06017006, 2017.

[66] F. Rizzo, Wind tunnel random processes statistics of pressures on a large span canopy roof. *Iranian Journal of Science and Technology, Transactions of Civil Engineering*, 10.1007/s40996-020-00458-x, 2020.

[67] F. Rizzo, P. Zazzini, Shape dependence of acoustic performances in buildings with a Hyperbolic Paraboloid cable net membrane roof. Journal of Acoustics Australia, 45 (2), 2017.

[68] F. Rizzo, P. Zazzini, Improving the acoustical properties of an elliptical plan space with a cable net membrane roof. Journal of Acoustics Australia, 44, 449-456, 2016.

[69] F. Rizzo, A. G. Kopp, G. Giaccu, Investigation of wind-induced dynamics of a cable net roof with aeroelastic wind tunnel tests. Engineering Structures, 229, 111569, 2021.

[70] F. Rizzo, C. Demartino, Pressure modes for hyperbolic paraboloid roofs. Curved and Layer Structure, 7, 1–21, 2021.

[71] F. Sadek, E. Simiu, Peak non-Gaussian wind effects for database-assisted low-rise building design. *Journal of Engineering Mechanics*, 128(5), 530-539, 2002.

[72] M. Gioffrè, M. Grigoriu, M. Kasperski, E. Simiu, Wind induced peak bending moments in low-rise building frames. *Journal of Engineering Mechanics* 126(8), 879–881, 2000.

[73] M. Grigoriu. Applied non-Gaussian processes, Prentice Hall, Englewood Cliffs, N.J. , 1995.

[74] X. Ma, F. Xu. Peak factor estimation of non-Gaussian wind pressure on high-rise buildings. *The Structural Design of Tall and Special Buildings*, 26(17):e1386, 2017.

[75] Q. Yang, X. Chen, M. Liu, Bias and sampling errors in estimation of extremes of non-Gaussian wind pressures by moment-based translation process models. *Journal of Wind Engineering and Industrial Aerodynamics*, 186, 214–233, 2019.

[76] H.W. Tieleman, Z. Ge, M.R. Hajj, Theoretically estimated peak wind loads. *Journal of Wind Engineering and Industrial Aerodynamics*, 95(2), 113–132, 2007.

[77] H.W. Tieleman, M.A.K. Elsayed, Z. Ge, M.R. Hajj, Extreme value distributions for peak pressure and load coefficients. *Journal of Wind Engineering and Industrial Aerodynamics* 96(6–7), 1111–1123, 2008.

[78] M.F. Huang, W. Lou, C.M. Chan, N. Lin, X. Pan, Peak distributions and peak factors of wind-induced pressure processes on tall buildings. *Journal of Engineering Mechanics*, 139(12), 1744-1756, 2013.

[79] M.F. Huang, S. Huang, H. Feng, W.J. Lou, Non-Gaussian time-dependent statistics of wind pressure processes on a roof structure. *Wind and Structures*, 23(4), 275-300, 2016.

[80] A. Naess, O. Gaidai, O. Karpa, Estimation of Extreme Values by the Average Conditional Exceedance Rate Method. Journal of Probability and Statistics, 2013, 797014, 2013.

[81] A. Naess, O. Karpa, Statistics of bivariate extreme wind speeds by the ACER method. *Journal of Wind Engineering and Industrial Aerodynamics*,139, 82-88, 2015.

[82] A. Naess, O. Gaidai, Monte Carlo methods for estimating the extreme response of dynamic systems. *Journal of Engineering Mechanics*,134(8),628–36, 2008.

[83] F. Rizzo, G. Di Lorenzo, A. Formisano, R. Landolfo, A time-dependent corrosion wastage model for Wrought iron Structures. *ASCE's Journal of Materials in Civil Engineering*, 31(8): 04019165, 2018.

[84] J. Ding, K. Gong, X. Chen, Comparison of statistical extrapolation methods for the evaluation of long-term extreme response of wind turbine. *Engineering Structures*, 57,100-115, 2013.

[85] X. Zhang, X. Chen, Assessing probabilistic wind load effects via a multivariate extreme wind speed model: A unified framework to consider directionality and uncertainty. *Journal of Wind Engineering and Industrial Aerodynamics*, 147, 30-42, 2015.

[86] O. Gaidai, A. Naess, X. Xu, Y. Cheng, Improving extreme wind speed prediction based on a short data sample, using a highly correlated long data sample. *Journal of Wind Engineering and Industrial Aerodynamics* 188 (2019) 102–109, 2019.

[87] X. Chen, Estimation of extreme value distribution of crosswind response of wind-excited flexible structures based on extrapolation of crossing rate. *Engineering Structures* 60, 177–188, 2014.

[88] A. Naess, O. Gaidai, Estimation of extreme values from sampled time series, *Structural Safety*, 31(4), 325-334, 2009.

[89] F. Rizzo, M. F. Huang, Peak value estimation for wind-induced lateral accelerations in a high-rise building, *Structure and Infrastructure Engineering*, in press.