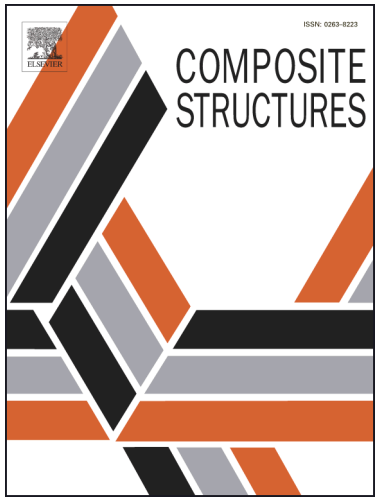

Probabilistic Defect Analysis of Fiber Reinforced Composites using Kriging and Support Vector Machine based Surrogates

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PII: S0263-8223(17)33948-X
DOI: https://doi.org/10.1016/j.compstruct.2018.03.007
Reference: COST 9454

To appear in: *Composite Structures*

Please cite this article as: Davidson, P., Waas, A.M., Probabilistic Defect Analysis of Fiber Reinforced Composites using Kriging and Support Vector Machine based Surrogates, *Composite Structures* (2018), doi: https://doi.org/10.1016/j.compstruct.2018.03.007

Probabilistic Defect Analysis of Fiber Reinforced Composites using Kriging and Support Vector Machine based Surrogates.

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Abstract

In this study a framework for analyzing defects and their effect on the performance of composites, using wavy fiber composites as a test case, is presented. The focus is on predicting the composite strength and failure mode in the presence of through thickness waviness. The framework utilizes surrogate models, derived from a high fidelity validated Finite Element analysis, to perform Monte Carlo simulations. The final analysis product that is developed is versatile enough to solve the forward and inverse problem, while considering partial or uncertain data as input.

Keywords: Composite compression, Defects, Kinking failure, Wavy composite, Surrogate modeling, Inverse analysis, Non Destructive Inspection
2010 MSC: 00-01, 99-00

*Nomenclature

α_p^n	Maximum angle of of n^{th} ply
α_d	Maximum angle of defect
α_w	Maximum angle of surface wave
β	Ply consolidation parameter
$\mathcal{M}$	Failure mode, split or kink
$\mathcal{N}$	$=\mathcal{N}(\mu,\sigma)$ Normal distribution with mean μ and standard deviation σ
ϕ	Ply stacking angle or propagation angle
$\mathbf{w}$	$=\{A_w,\alpha_w\}$, Set containing surface wave parameters
$\mathbf{x}$	$=\{A_d,\alpha_d,N_p,\beta\}$, Set containing defect and consolidation parameters
$\mathbf{y}$	$=\{X_c,M\}$, Set containing compressive strength output and failure mode parameters
A_d	Amplitude of defect
A_w	Amplitude of surface wave
h_c	$=(N_pT_p+(N_p-1)T_m)$, Depth of defect location from the top surface
L_p^n	Misalignment length of n^{th} ply

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