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Simulation of Glass Breakage Using Voronoi Random Field Tessellations

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Abstract : Fragmentation analysis of tempered glass gives insight into the quality of the tempering process and defines a certain degree of safety as well. Different standard such as the European EN 12150-1 or the American ASTM C 1048/CPSC 16 CFR 1201 define a minimum number of fragments required for soda-lime safety glass on the basis of fragmentation test results for classification. This work presents an approach for the glass breakage pattern prediction using a Voronoi Tesselation over Random Fields. The random Voronoi tessellation is trained with and validated against data from several breakage patterns. The fragments in observation areas of 50 mm x 50 mm were used for training and validation. All glass specimen used in this study were commercially available soda-lime glasses at three different thicknesses levels of 4 mm, 8 mm and 12 mm. The results of this work form a Bayesian framework for the training and prediction of breakage patterns of tempered soda-lime glass using a Voronoi Random Field Tesselation. Uncertainties occurring in this process can be well quantified, and several statistical measures of the pattern can be preservation with this method. Within this work it was found, that different Random Fields as basis for the Voronoi Tesselation lead to differently well fitted statistical properties of the glass breakage patterns. As the methodology is derived and kept general, the framework could be also applied to other random tesselations and crack pattern modelling purposes.

Keywords : glass breakage predicition, Voronoi Random Field Tessellation, fragmentation analysis, Bayesian parameter identification
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