The energy budget of Fiber Bundle Model

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Fiber bundle model (FBM) captures correctly the stress-induced failure behavior of disordered materials under external loading. In general, the non-linear stress strain curve (load curve) assumes a parabolic shape and the maximum point of the load curve gives the strength of the system. The system goes unstable after crossing that maximum point (failure point) and catastrophic failure occurs (the system collapses). We have calculated the elastic energy and damage energy of an equal-load-sharing FBM during the entire failure process. While the damage energy gradually increases with strain, the elastic energy shows a peak in the unstable phase of the system. In addition, the slope of the elastic energy versus strain curve has a maximum that appears always before the failure point (in the stable phase of the system) --- therefore it can be used as a reliable signal of upcoming catastrophic failure. The theoretical analyses are done for power law type and Weibull distributions of fiber thresholds and all the theoretical estimates are verified by numerical simulations on a single FBM having large number of fibers (10 Million).

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