Characterizing the failure properties of materials from the statistical analysis of their fracture surfaces

Industry is always looking for cheaper, simpler, and more reliable techniques to measure the mechanical properties of material, especially when it relates to their resistance to failure like toughness.

However, the state-of-the-art technique remains rather costly and complex to implement, as it requires the instrumented test of a notched specimen. On top of it, it provides only a single value of toughness per sample that may not account for the variations of resistance from one location to another that is inherent to the heterogeneous nature of materials.

To address these challenges, we propose a complementary method of material characterization based on the statistical analysis of their fracture surface. As I will show in this presentation, it by-passes the needs for an instrumented test by allowing for the measurement of the failure properties of a material from the analysis of a mm² map of its fracture surface. It also gives access to the field of resistance of a material, thus quantifying the heterogeneities of resistance like the weakest regions.

The application of this method in failure analysis, material characterization and predictive maintenance will also be discussed.