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Numerical model of the variability of particulate filled structural adhesive behaviour and failure in tension

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In this work, we are interested in simulating the variability of the experimental behaviour of tensile tests in terms of ultimate tensile stress and strain of a solid adhesive filled with different percentages of particles. Particle-filled adhesives are of great importance in the design for disassembly or demise (D4D) development of durable structures [1]. For ground applications of space structures for example, such as laboratory testing of expensive devices, these adhesives are very useful for recovering the device after testing. It is therefore necessary to be able to predict the strength of the bonded assembly to allow a good ground test and to be sure of disassembly at the end. The most commonly used adhesive is EC2216. This type of adhesive is known to exhibit some variability in stress and strength characteristics at room temperature, over the whole spectrum of possible loading rates [2]. Therefore, it is mandatory to have a numerical model that can be used to predict durability and failure taking into account this variability. The well-known Weibull-type probabilistic distribution is chosen here to reproduce the macroscopic force-displacement curve and brittle fracture that are observed in the tests. The probabilistic behaviour can be represented by a macroscopic property distribution to represent the local variation in each finite element of the LS-DYNA model. Comparisons are made between simulations and tests to analyse the influence of the initial numerical parameters of strength and stress-strain behaviour distribution, as well as the Poisson's ratio, on the macroscopic failure. The sensitivity of the mesh density is studied, as it is related to the statistical distribution of properties.

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