THE EFFECT OF POROSITY ON THE MILLING OF METAL FOAMS

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ABSTRACT –
The significance of porous materials is continuously increasing, with porosity being one of the most determinant factors to fulfil the application requirements. Among them, porous aluminium is the most used, due to its low melting point, low weight and ease of manipulation. Although porous aluminium is near-net-shape fabricated, usually, a finishing step is essential to reach the tolerances of the selected application. The present work presents the effect of porosity on the milling on porous aluminium, through a computational-experimental framework. The porous geometries of 65%, 70% and 75% porosity were reconstructed by a Voronoi-based CAD algorithm to much the geometrical characteristics of the real foam. A FEM model of the 3D closed-cell porous geometry was built to simulate the milling process. ANSA was efficiently used in the initial meshing and as a tool for remeshing the porous geometry when it was severely distorted during milling. The cutting forces monitored during milling were correlated with the FEM-calculated ones, revealing a good convergence. Depending on the porosity, the chip evolution and fragmentation mechanisms vary, leading to multiple force fluctuations in a single cut and burr formation. There is an optimum window of cutting conditions that allows for a minimum distortion of the porous geometry during milling, depending on the porosity.