Injection molding is a manufacturing process for producing shell-like parts by injecting molten material into a mold. As the part cools down, residual stresses build up due to inhomogeneities in the process and the thermomechanical properties of the material. In order to relax these stresses, the part experiences large out-of-plane deformations, a phenomenon known as buckling.

Mathematically speaking, buckling is a bifurcation in the solution of the non-linear equations of static equilibrium (Foppl-von Karman equations). The aim of the work was to compute the minimum cooling temperature required for buckling and the amplitude of the vertical deformation of disks molded out of a polymer containing short glass fibers. The qualitative and quantitative behavior was investigated as function of the fiber orientation across the thickness of the part.

A skin-core-skin geometry was studied. A perturbation scheme, in combination with a Legendre-Galerkin approach, was used to compute the first buckling mode. The results showed that the predominant fiber orientation (radial or tangential) determines the type of buckling (bowl- or saddle-like). Moreover, the existence of a critical skin-to-core thickness ratio yielding no buckling was proven. Good agreement with FEM simulations and experimental results available in the literature was also obtained.