

Optimal Design of Propellant Grain Shape Based on Structural Strength Analysis

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Abstract : Experiment and simulation researches on the structural integrity of propellant grain in solid rocket motor (SRM) with high volumetric fraction were conducted. First, by using SRM parametric modeling functions with secondary development tool Python of ABAQUS, the three dimensional parameterized modeling programs of star shaped grain, wheel shaped grain and wing cylindrical grain were accomplished. Then, the mechanical properties under different loads for star shaped grain were obtained with the application of automatically established finite element model in ABAQUS. Next, several optimization algorithms are introduced to optimize the star shaped grain, wheel shaped grain and wing cylindrical grain. After meeting the demands of burning surface changes and volumetric fraction, the optimum three dimensional shapes of grain were obtained. Finally, by means of parametric modeling functions, pressure data of SRM's cold pressurization test was directly applied to simulation of grain in terms of mechanical performance. The results verify the reliability and practical of parameterized modeling program of SRM.

Keywords : cold pressurization test, parametric modeling, structural integrity, propellant grain, SRM

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