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Scattering of shock waves by random roughness

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We employ second-order stochastic perturbation analysis and stochastic simulations synergistically to study supersonic flow past a rough wedge. The roughness is modeled as a stochastic process obtained from a new stochastic equation. We derive explicit formulas for the perturbed solution, which along with the stochastic simulation results aid to elucidate the physical scaling laws. For small roughness height and correlation length, the mean of the perturbed pressure scales quadratically with the height and the inverse correlation length while the corresponding variance scales linearly. Our results are useful in evaluating the effects of roughness in high-speed flight but also in designing novel enhanced-lift aerodynamic surfaces using rough skin concepts.