Based on [Feireisl and Lukáčová-Medvid'ová, 2023], we propose a stochastic collocation approach combined with the viscosity finite volume (VFV) method to solve numerically the complete Euler system with random initial data.
Convergence of the sequence of numerical approximations is proven under the assumption that the discrete differential quotients remain bounded in probability.
We prove a new discrete conditional regularity property of the VFV method: If the discrete differential quotients of the sequence of numerical approximations remain bounded, the sequences converge to a strong solution of the Euler system.
Besides the boundedness in the probability of the discrete differential quotients and assumptions on the regularity of the initial data, no additional information on the probability measure is required to prove the convergence of the stochastic collocation VFV scheme. Thus, the scheme can be used even without prescribing the probability distribution of the initial data.
Numerical tests illustrate our theoretical findings.

References:
[Feireisl and Lukáčová-Medvid'ová, 2023] E. Feireisl and M. Lukáčová-Medvid'ová: Convergence of a stochastic collocation finite volume method for the compressible Navier-Stokes system, Ann. Appl. Probab. 33, 4936-4963 (2023).