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A computational framework for the quantification of rare events in systems with instabilities[1] THEMISTOKLIS SAPSIS, MUSTAFA MOHAMAD, WILL COUSINS, MIT — We consider the problem of probabilistic quantification of dynamical systems exhibiting heavy tailed distributions. These heavy tail features are associated with rare transient re- sponses due to the occurrence of internal instabilities. Systems with these characteristics can be found in a variety of areas including mechanics, fluids, and waves. Here we are interested for the development of a computational approach, a probabilistic-decomposition-synthesis method that will take into account the nature of these internal instabilities and will inexpensively provide the non-Gaussian probability density function for the quantities of interest. Our approach relies on the decomposition of the statistics to a stable Gaussian core and a heavy-tailed distribution. Statistics in the stable region are analytically characterized using a Gaussian approximation approach, while the non-Gaussian distributions associated with the intermittently unstable region of the phase space, are inexpen- sively quantified through reduced-order methods. Applications are presented for nonlinear water waves as well as subjected mechanical systems.

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