Like interval-analysis, at each step of the propagation, every multiplication pessimistic estimates: especially a concern when designs are more aggressive

Moment Matching
Approximate the exact solution of AB by the affine form

Incorporate the proposed MOG propagation procedure to SSTA

Affine Operations—addition and subtraction

Polynomial Chaos

INTRODUCTION

The number of Gaussians in the mixture is determined by the number of desired moments that need to be preserved through the propagation

E.g: a 1-D Gaussian mixture with k components can capture the output distribution up to 3k-1's moments

SPICE-level MOG Propagation

At the end of each time step t of the SPICE simulation, the output voltage or other performance of interests can be modeled as a nonlinear function of the process parameters and the nodal voltages at time t-1

Solution: Use Mixture of Gaussian(MOG) to capture the non-Gaussianity

Mathematical: \( P(x) = \sum_{i=1}^{K} w_i N(\mu_i, \Sigma_i), \sum_{i=1}^{K} w_i = 1 \)

Goal: find a mixture of Gaussian approximation for this quantity

Like interval-analysis, at each step of the propagation, every quantity is approximated by a Gaussian Mixture

Future Goals

Integration of the methodology into chip-level Statistical Static Timing Analysis (SSTA) engine

The distribution obtained from the SPICE-level uncertainty propagation can be used as inputs to the SSTA engine

Incorporate the proposed MOG propagation procedure to SSTA