FACULTY OF ENGINEERING AND ARCHITECTURE

HYBRID PROBABILISTIC-POSSIBILISTIC APPROACH FOR ADDRESSING UNCERTAINTY IN ELECTROMAGNETIC COMPATIBILITY MODELS

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RESEARCH TOPIC

Hybrid Probabilistic – Possibilistic Problems

- Given the deterministic model

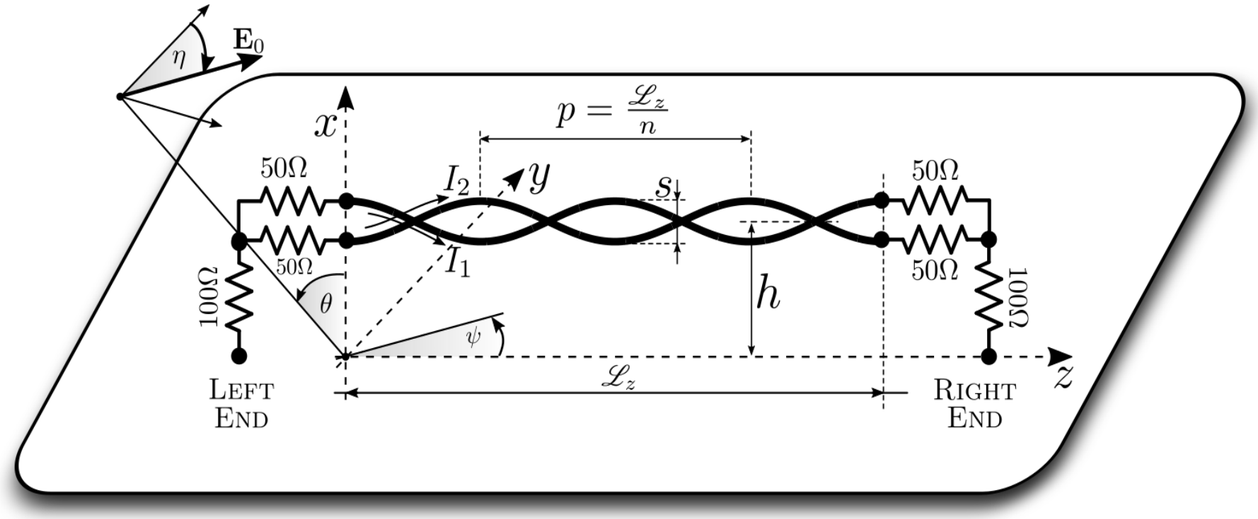
$$z = f\left(\underbrace{r_1, r_2, \ldots, r_T}_{random}, \underbrace{F_{T+1}, F_{T+2}, \ldots, F_M}_{fuzzy}\right)$$

with M parameters

  - T random variables with known probability distribution
  - (M-T) fuzzy variables with known possibility distribution

- Goal: estimate the variations of z in terms of cumulative distribution function (CDF) confidence bounds

- Field coupling to a Twisted-Wire Pair (TWP)
  - TWP running above a ground plane
  - Balanced terminations to prevent CM-to-DM conversion
  - Uniform plane-wave illumination



h	5 cm
r_w	0.5 mm
s	4 mm
L_z	2 m
E	1 V/m

Goal: Evaluate DM currents induced in terminal loads

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– Polynomial Chaos (PC) Expansion

$$Y\left(t,\vec{\xi}\right) \cong \sum_{i=0}^{M} \alpha_i\left(t\right)\varphi_i\left(\vec{\xi}\right)$$

$Y\left(t,\vec{\xi}\right)$: stochastic process

$\vec{\xi}$: vector of normalized random variables

φ : polynomial basis functions

α : PC coefficients

– Idea: PC for Probabilistic – Possibilistic Problems

$$Y\left(t,\vec{\xi}\right) \cong \sum_{i=0}^{M} \alpha_i\left(t\right)\varphi_i\left(\vec{\xi}\right)$$

- Y is the min / max of the quantity of interest
  - Frequency-dependent DM mode current

$$\min\left(I_{DM}\left(\omega,n,\theta,\eta,\psi\right)\right) \cong \sum_{i=0}^{Q} \alpha_i\left(\omega,n,\theta\right)\varphi_i\left(\eta,\psi\right)$$

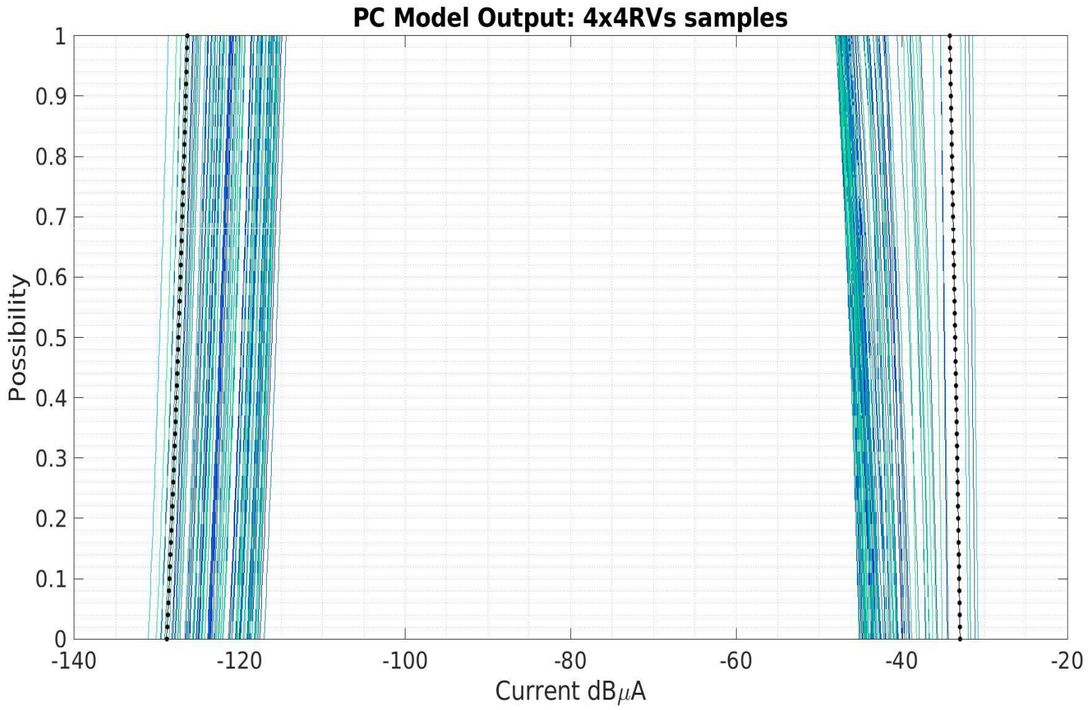
Angular frequency

Possibilistic variables

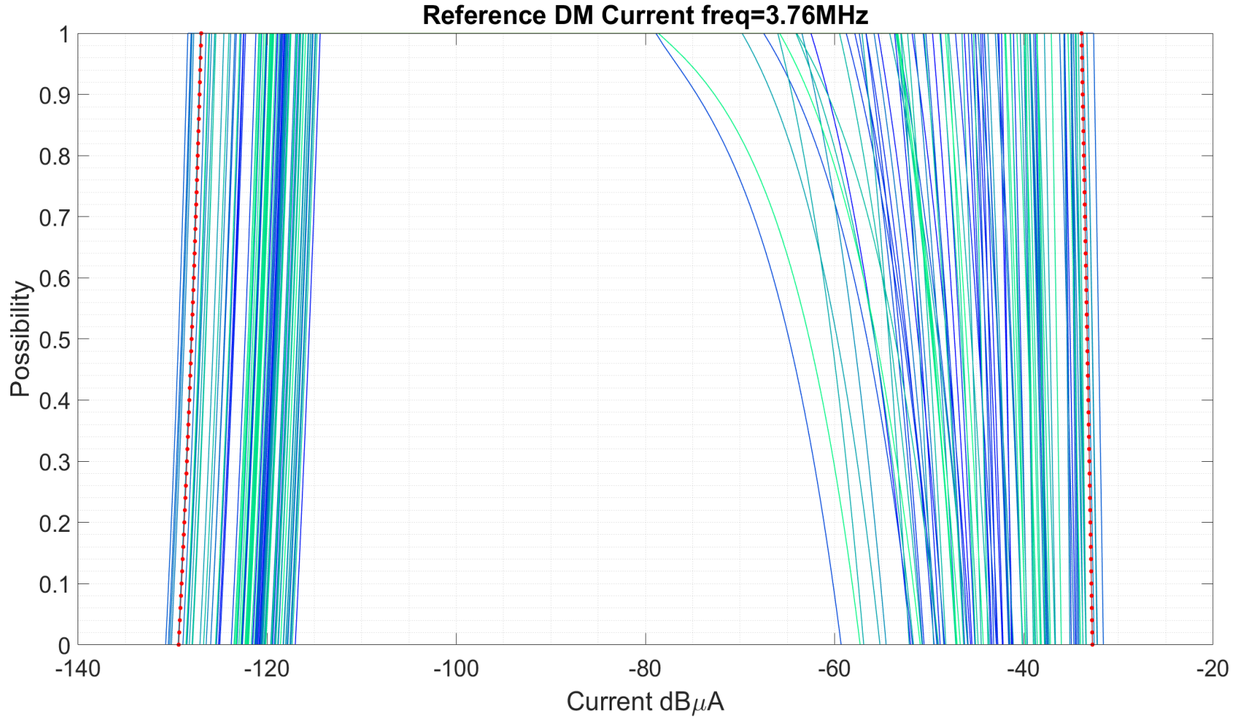
Random variables

– Field coupling to a Twisted-Wire Pair (TWP): Results

Polynomial Chaos – based



Monte Carlo – based



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