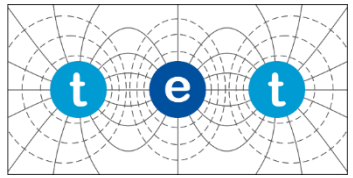
FEM-BASED STATE SPACE CONCATENATION FOR COUPLED RF CAVITY SIMULATION



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Motivation

Simulation of large coupled electromagnetic systems remains computationally prohibitive

Objective

Development of an open-source FEM library for scalable state-space concatenation of large electromagnetic systems.

[1] T. Flisgen, J. Heller, T. Galek, L. Shi, N. Joshi, N. Baboi, R. M. Jones, and U. van Rienen, Eigenmode compendium of the third harmonic module of the European X-ray Free Electron Laser, Phys. Rev. Accel. Beams 20, 042002, 2017, doi: https://doi.org/10.1103/PhysRevAccelBeams.20.042002
[2] T. Wittig, R. Schuhmann, and T. Weiland, Model order reduction for large systems in computational electromagnetics, Linear algebra and its applications, vol. 415, no. 2-3, pp. 499-530, 2006
[3] J. Schöberl, C++ 11 implementation of finite elements in NGSolve, Institute for Analysis and Scientific Computing, Vienna University of Technology, 30, 2014, ngsolve.org/_static/ngs-cpp11.pdf

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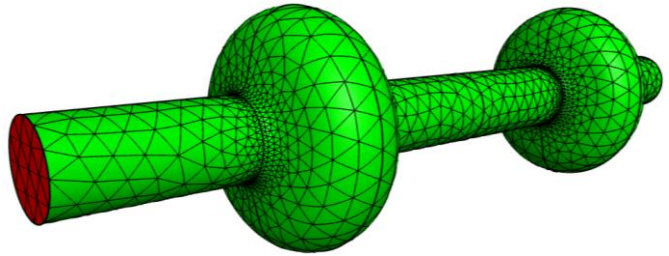
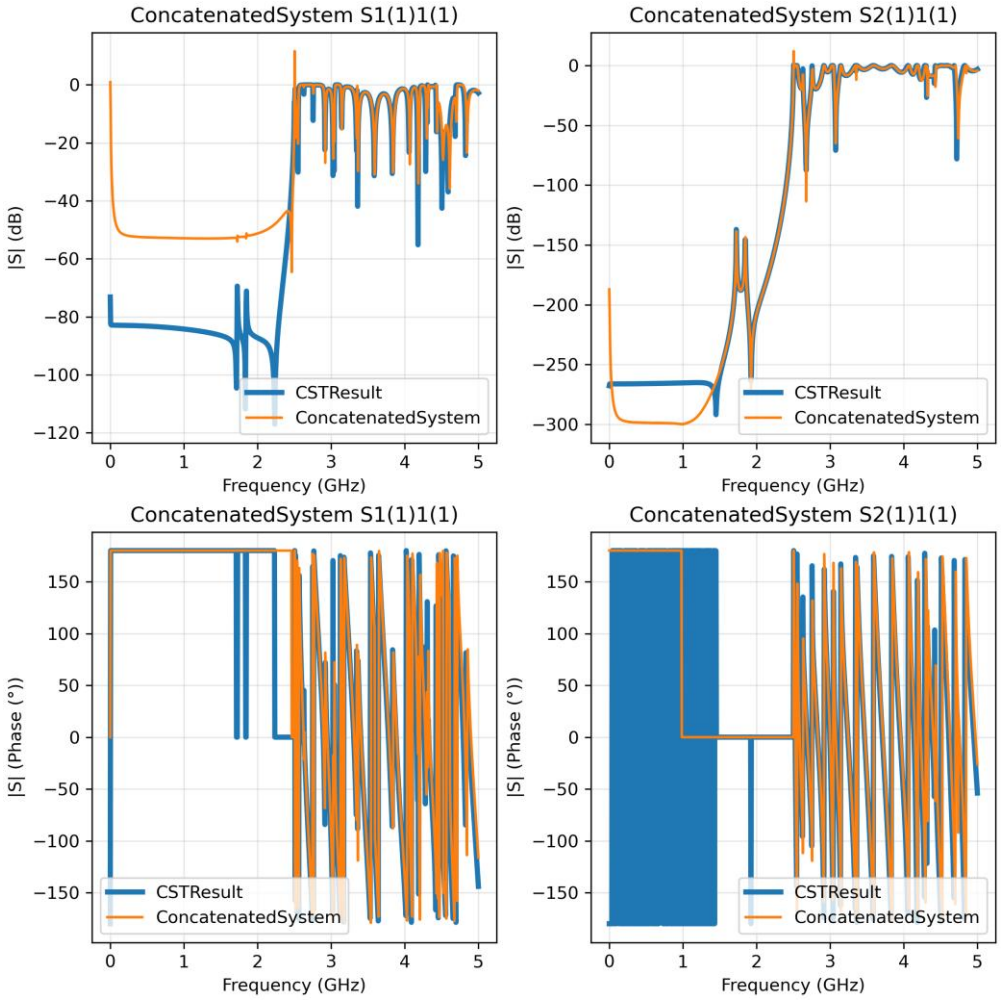
1. FEM → 2. MOR → 3. CONCATENATION



State space concatenation summary			
Full FEM Model		Reduced Model (ROM)	
Cavity 1	Cavity 2	Cavity 1	Cavity 2
112,804 DOFs	110,580 DOFs	154 DOFs	154 DOFs
Total 223,474 DOFs		Coupled System 308 DOFs	
~99.86% Compression		**$223,474 \rightarrow 308$ DOFs**	



Comparison of Scattering Parameters: CST Simulation vs. Concatenated System Model