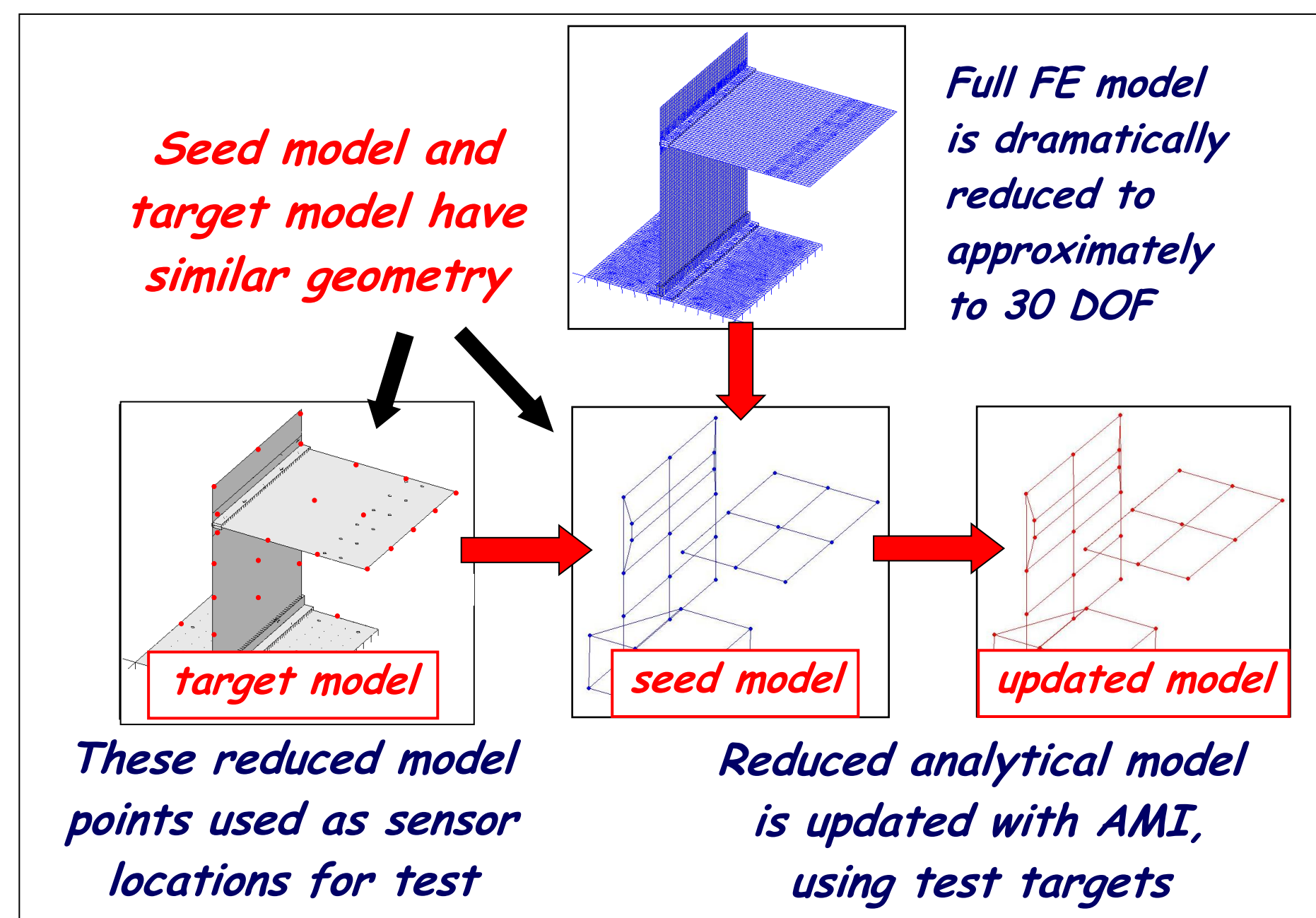


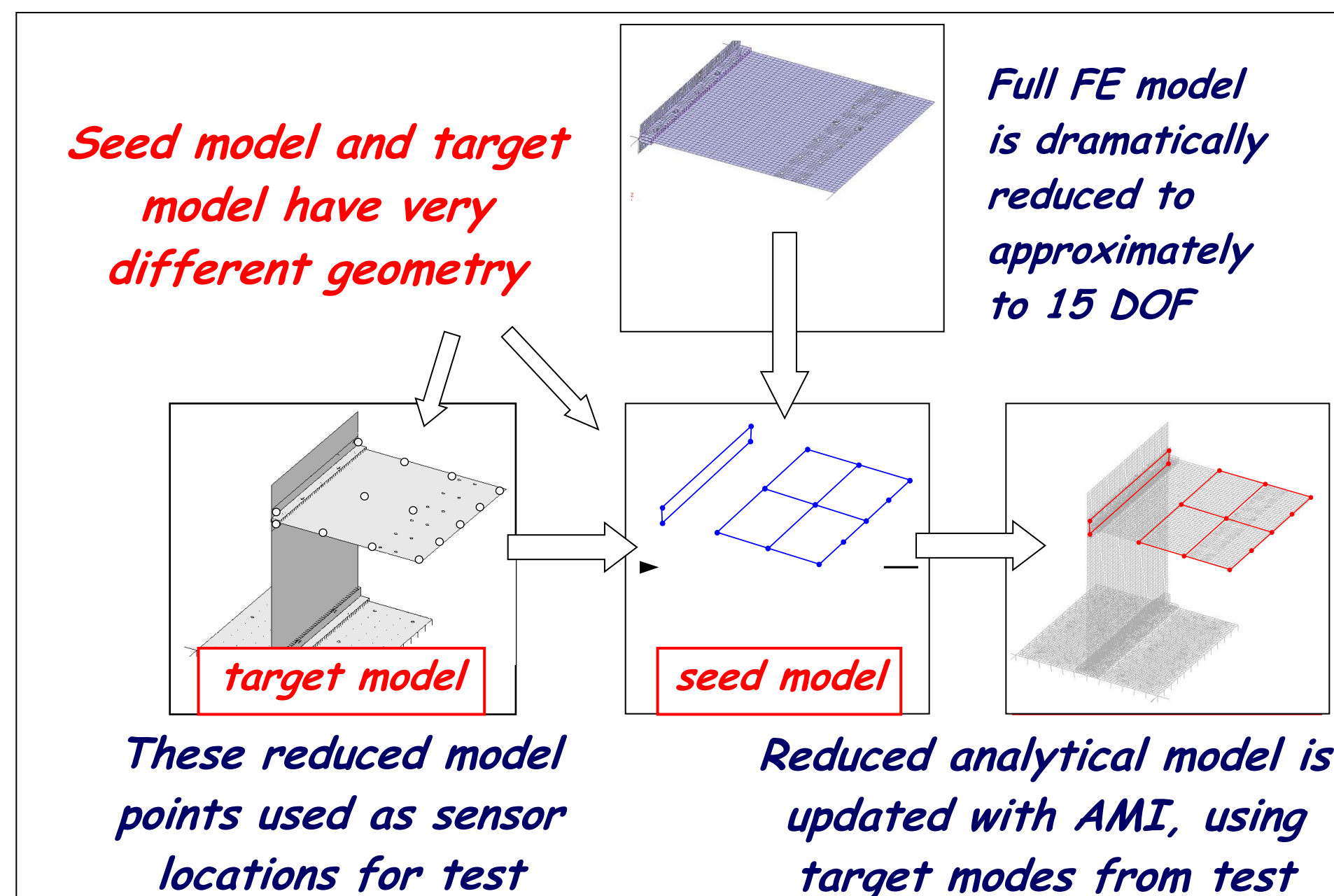
# REDUCED ORDER, TEST VERIFIED COMPONENT MODEL SYSTEM METHODS FOR MULTIBODY DYNAMIC SYSTEM APPLICATIONS FOR HELICOPTER/MISSILE/WING CONFIGURATIONS

Tracy Van Zandt, Nels Wirkkala, Adam Butland, Dana Nicgorski, Chris Chipman, Aaron Williams, Peter Avitabile

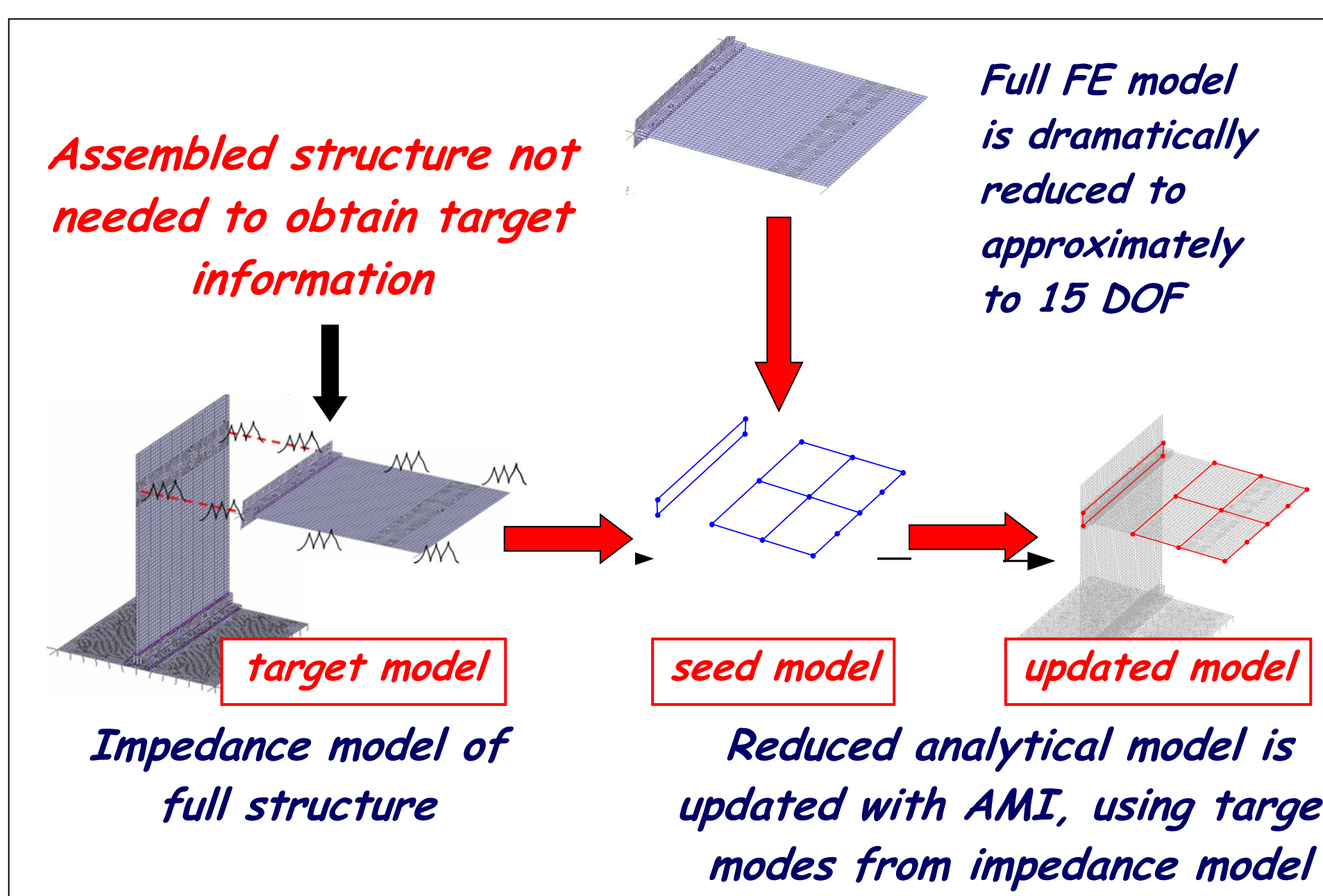
**Modal Based System Response - MBSR**  
Complete System Model Reduction with Direct Updating - Modeling technique usually employed in many instances and provides very good results. Requires full model representation



**Modal Based Component Response - MBCR**  
Reduced Component Model Updating from Assembled System Response - Advantage of technique is that only part of the structure needs to be modeled (such as component) but direct model updating is performed using test data from complete system assembly. This technique requires that the system targets be obtained from an assembled system



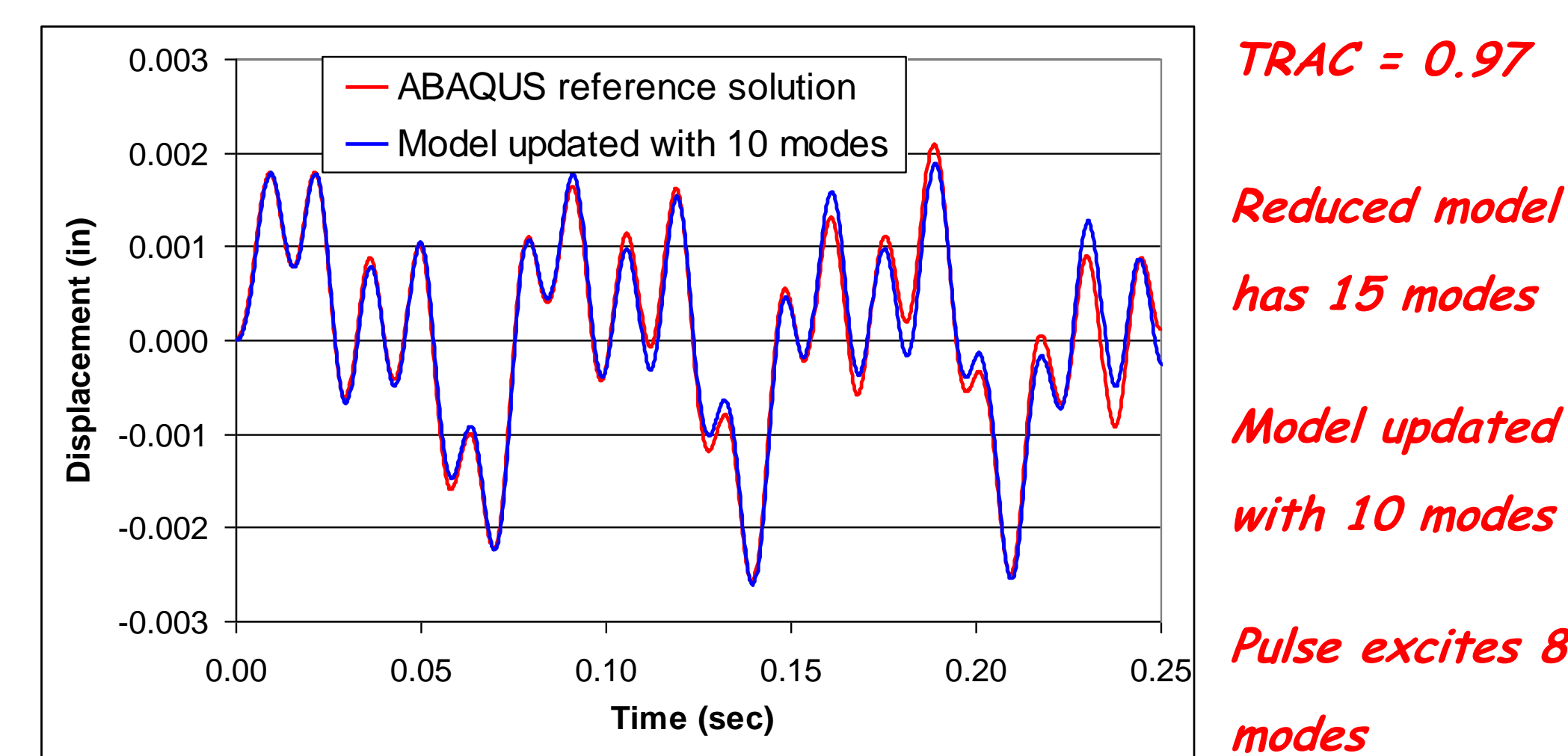
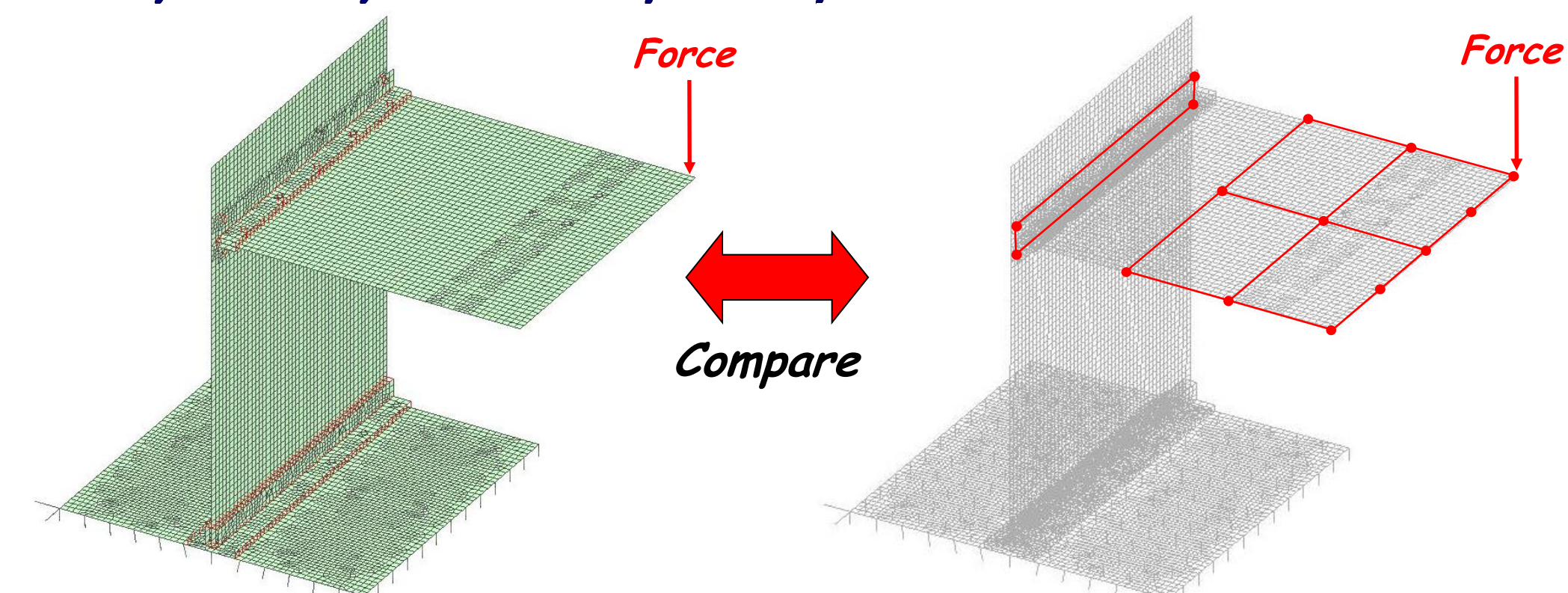
**Frequency Based Component Response - FBCR**  
Reduced Component Model Updating from Impedance Developed Model for System Characteristics - Similar to MBCR but the system targets are obtained from component information used to form a frequency based substructure. This implies that the components do not need to be assembled for system targets



**Modal Based System Response - MBSR**  
**Modal Based Component Response - MBCR**  
**Frequency Based Component Response - FBCR**

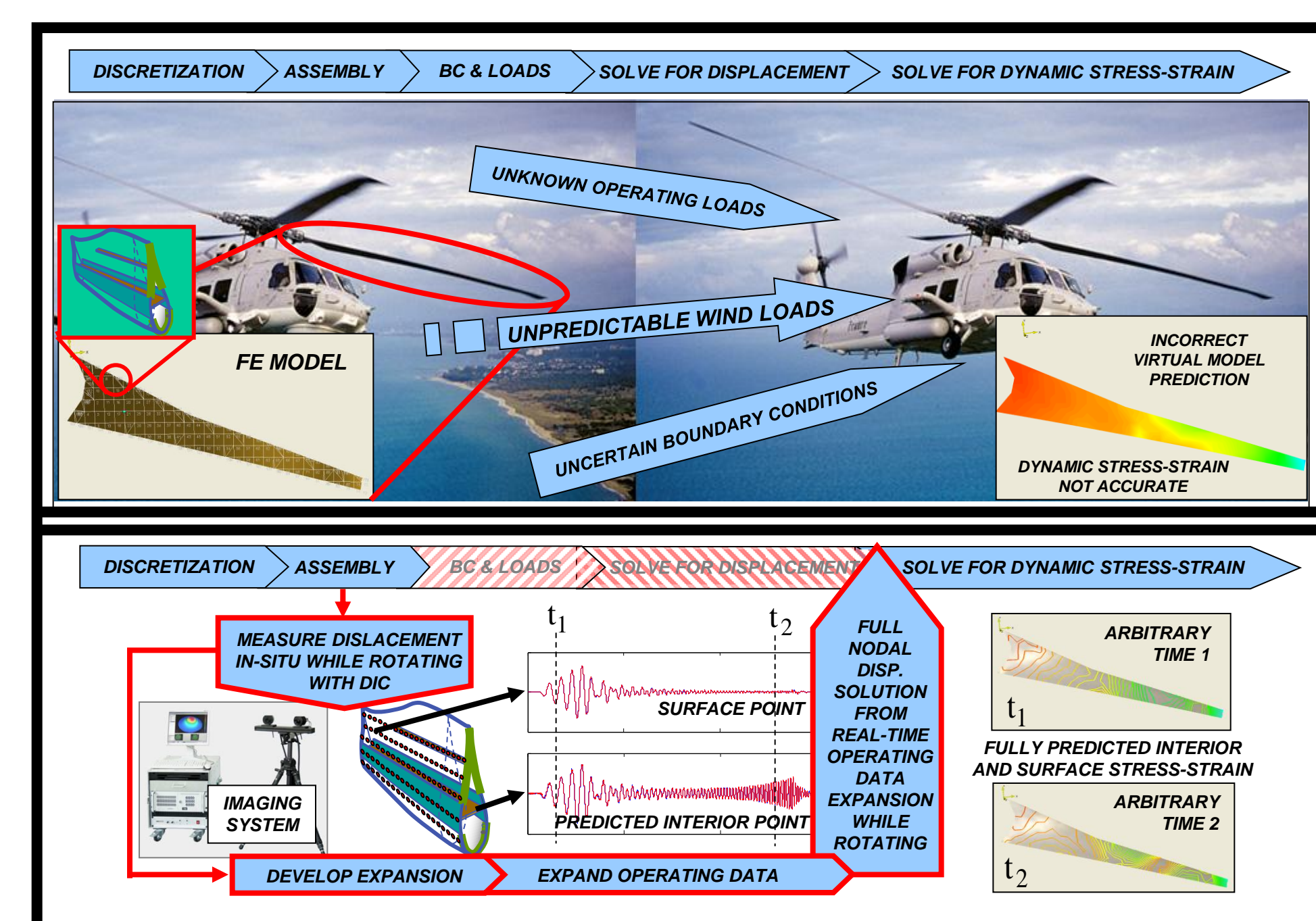


All three techniques provide very different approaches for solving these complicated problems. All models were checked for both flexibility and dynamic response prediction.



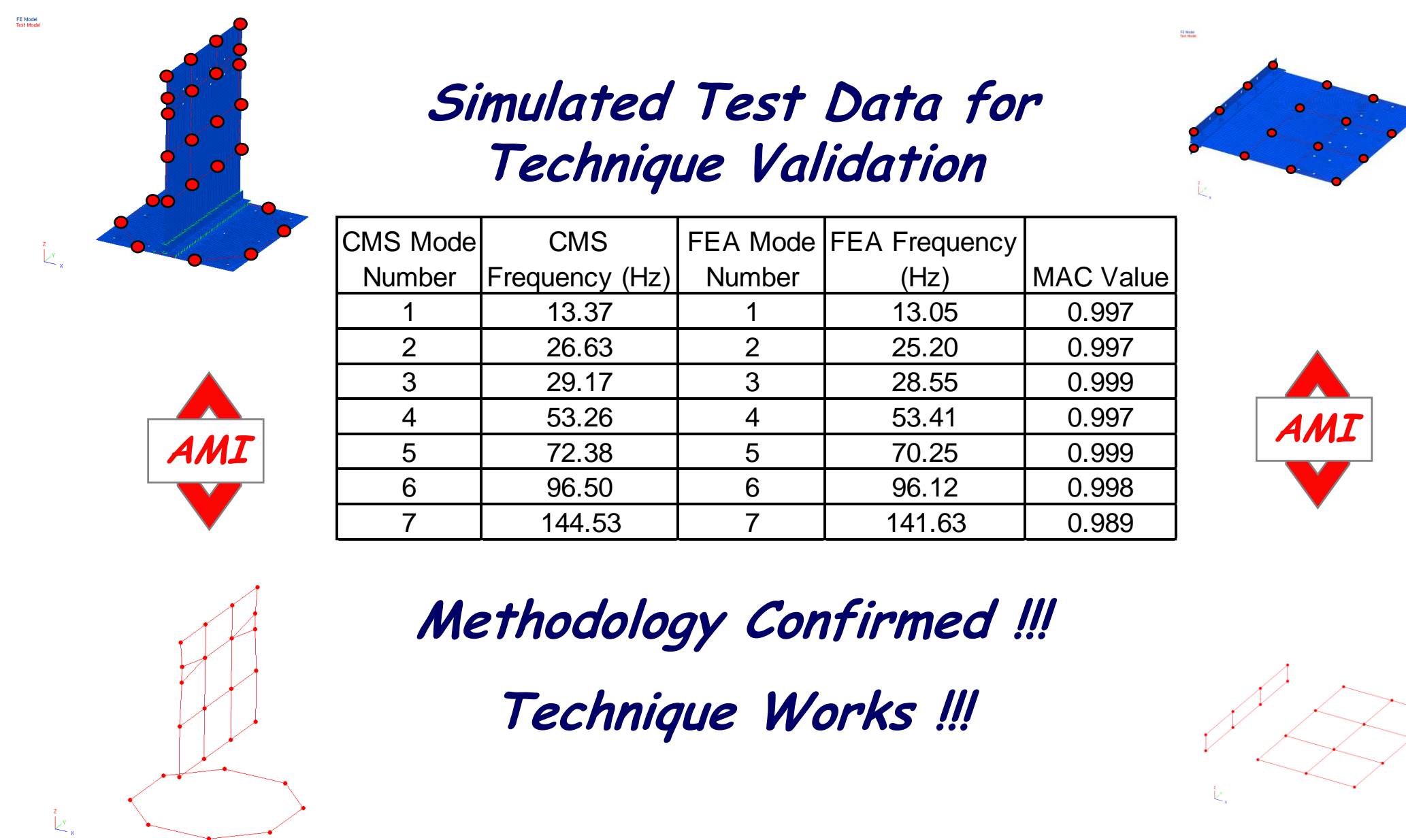
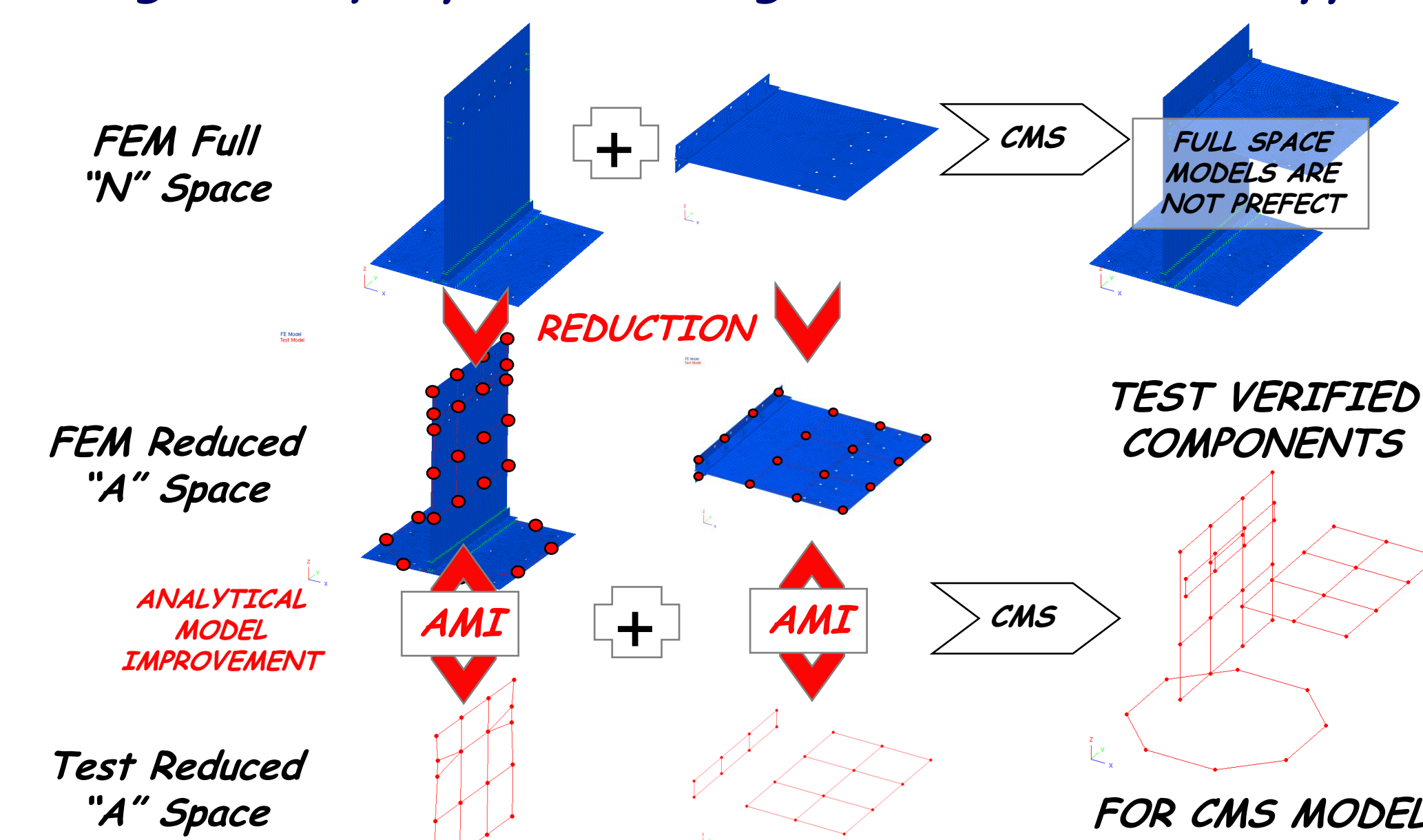
## REAL TIME DYNAMIC STRESS-DYNAMIC STRAIN

Utilizing and extending real time operating data expansion techniques allows for new approaches for prediction of dynamic stress and dynamic strain in rotating and non-rotating systems



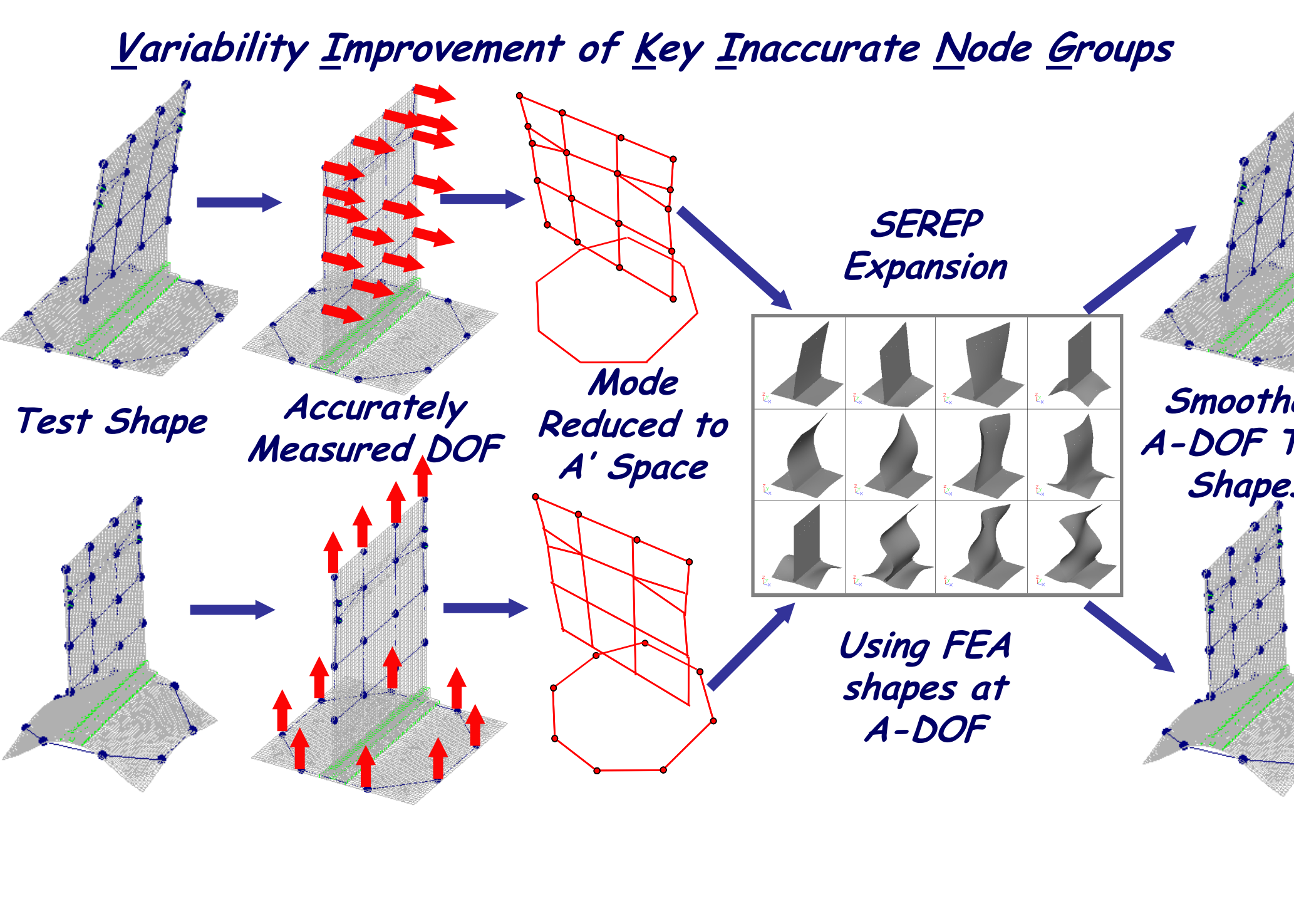
These efforts are currently under research investigations

**Craig Bampton Component Response - CBCR**  
Test Verified, Reduced Order Component Models used to form Craig Bampton Component Mode Synthesis Models - Individual components are reduced and then updated using a direct updating technique prior to being used for CB-CMS approach



## ALL MEASURED DATA WILL SUFFER FROM IMPURITIES

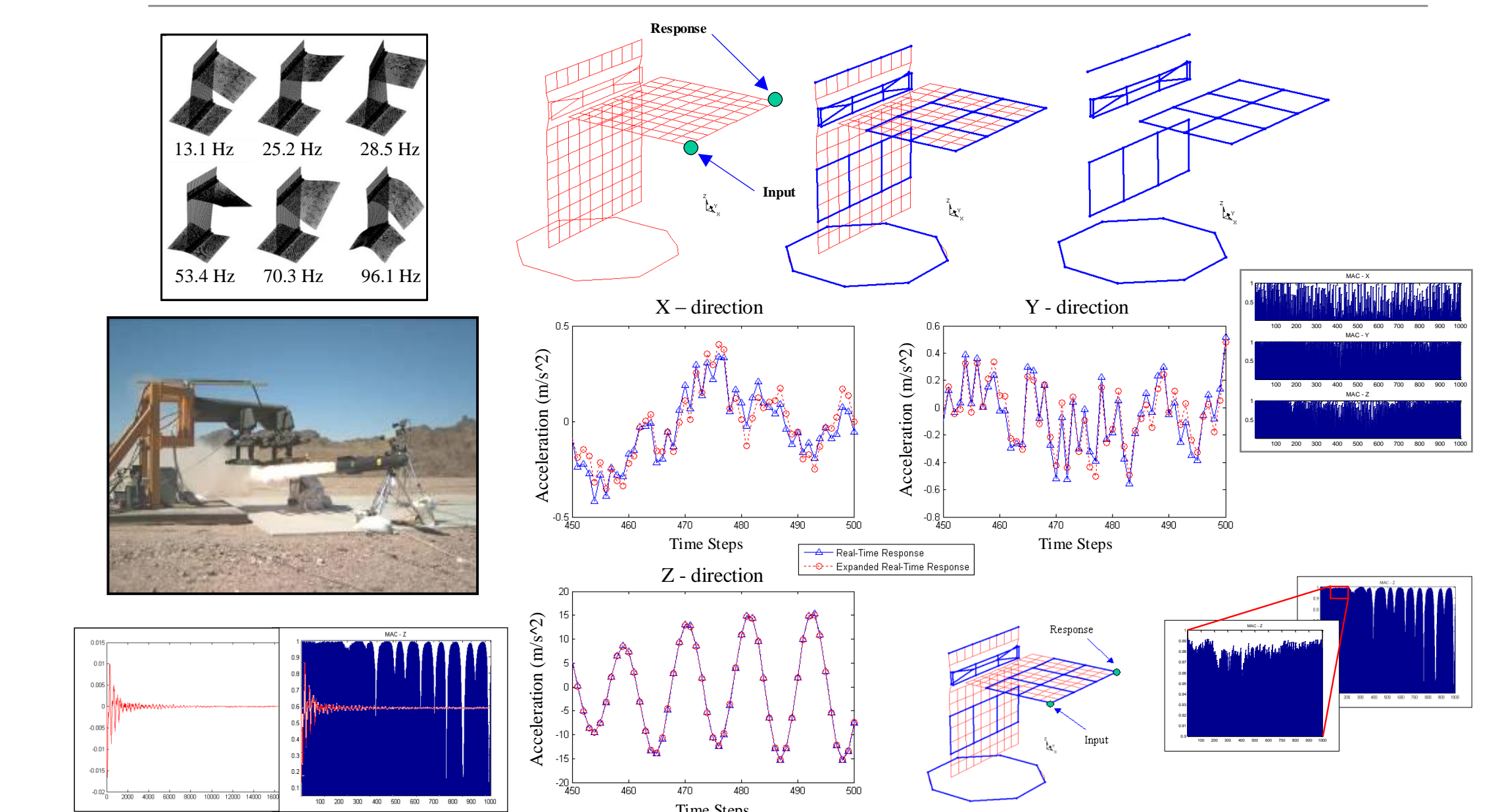
The VIKING Technique enables necessary data cleansing approaches to improve data for all processing performed. It is imperative that this be done for data collected. Early studies show that this is a major breakthrough for processing measured data and overcomes problems that have plagued these approaches for decades.



## Real Time Operating Data Expansion allows for Improved Visualization

Operating data is often collected at a limited set of points. Interpretation of this "strawman" data is often confusing. Expansion techniques are employed to optimize and visually enhance this important data to allow for better interpretation.

Expansion functions can be developed from experimental modal test results. Another possibility uses the analytical model for expansion and allows for the computation of real time operating dynamic stress and strain which is extremely useful



**Vibrant Technology, Inc.**

Hardware and software tools employed

**FEMAP** **PCB PIEZOTRONICS** **LMS** **FEMtools**

## Overlay of measured and VIKING Smoothed FRFs

