# *Using <u>Advanced Energy Methods</u> to Enhance Test & Simulation Data Analysis*
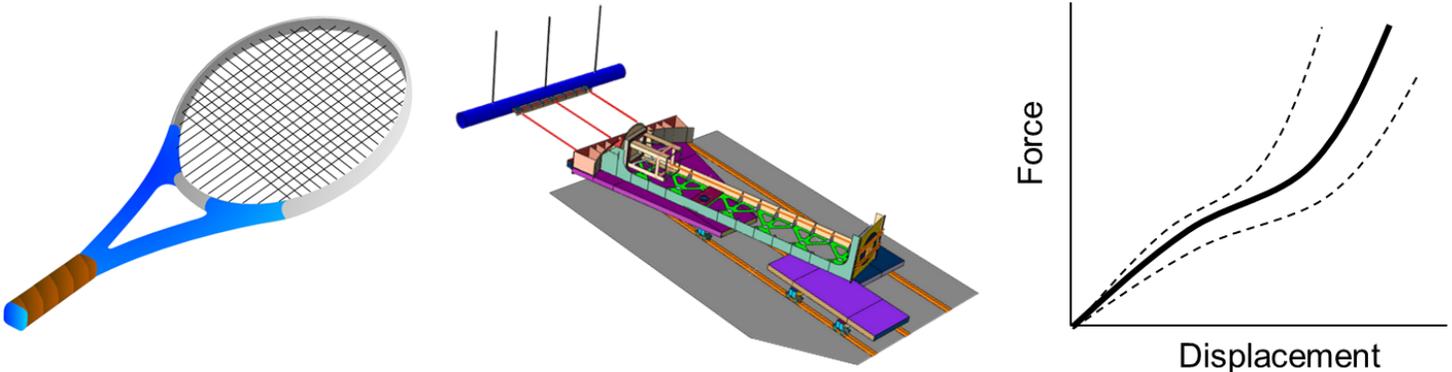
**NEW**

## Customizable Training Seminar
### *Instructor: Ted Diehl, PhD*

$$\frac{\partial(WK)}{\partial(u)} = F_{applied} = \frac{\partial(IE)}{\partial(u)} + \frac{\partial(KE)}{\partial(u)} + \frac{\partial(FD)}{\partial(u)} = \Phi_{IE} + \Phi_{KE} + \Phi_{FD}$$

- Estimate Dynamic Impact Behavior Using Static Data and Energies
- Efficiently Determine What to Change w/ <u>One Model Run</u> & Causality Analysis



**Force** vs **Displacement**

## *Training specially designed for FEA Users & Test Engineers*

### Course Description

This training seminar teaches how to use energy quantities (external work, internal energy, frictional dissipation, inelastic energy, artificial energy, etc.) and derivatives of such energy quantities to significantly enhance your analysis methods.  The methods are applicable to a large range of problems, quasi-static to dynamic as well as linear to non-linear. This course is applicable to both physical tests and FEA simulations.

### Benefits of Training

- Gain increased insight into your existing results (their validity and potential additional understanding)
- Estimate impact behavior (displacements, strains, and stresses) using quasi-static data and energy
- Create additional predictions from a single base dataset (single model result set or physical test dataset)
- Use energy derivatives and causality analysis to potentially reduce the number of tests and/or simulations run in design studies
- Correct and adjust results from models that are distorted by numerical issues  (artificial stability forces in implicit simulations, inertial loading in quasi-static explicit simulations,  etc.)

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### Topics

**Conservation of Energy and the Energy Balance**

**Classic Use of Checking Energies for Assessing FEA Model Validity**

**Using Energy Methods to Estimate Impact Behavior From Quasi-Static Data (Both Test & FEA)**
- Linear problems
- Nonlinear problems

**Causality and Energy Derivatives—Defining the Concept**

**Assessing Causality Within a Structure or Component**

**Correcting and Adjusting Models to Remove Undesirable Numerically-Induced Distortions**

**Creating Lightening-Fast Additional Predictions From a Single Dataset**
- *AKA—How to make design sensitivity predictions and calculate new results from only a single model run or physical measurement.*

### Application Demonstrations

**Physical Testing Data—How to Get Much More Using Energy Methods**

**Implicit Quasi-Static Simulations from FEA and Other Models**
- General applications
- Assessing the influence of artificial stability methods on solution results

**Transient Solutions, Particularly from Explicit Dynamics**
- Need for DSP filtering
- General applications

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### Who Should Attend

Engineers, scientists, and technicians working with physical test data or simulation models.

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*Email course inquires to info@BodieTech.com*
*½-day & 1-day options via web or at customer's site*

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