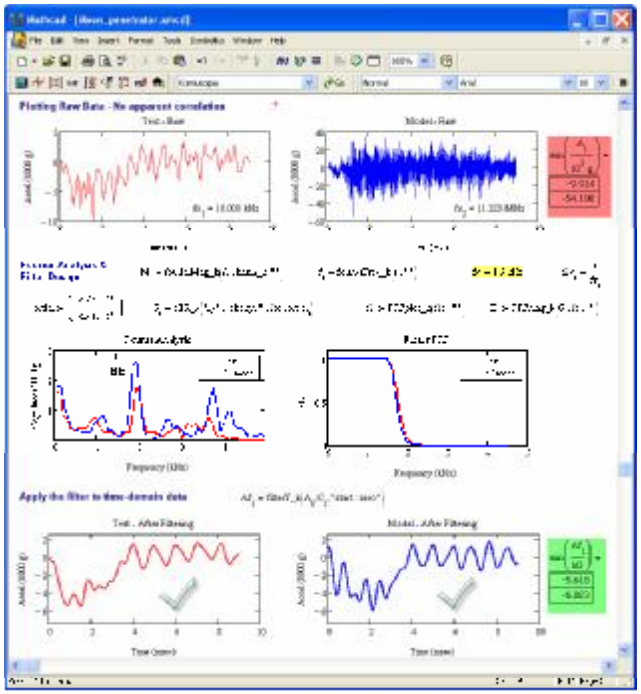
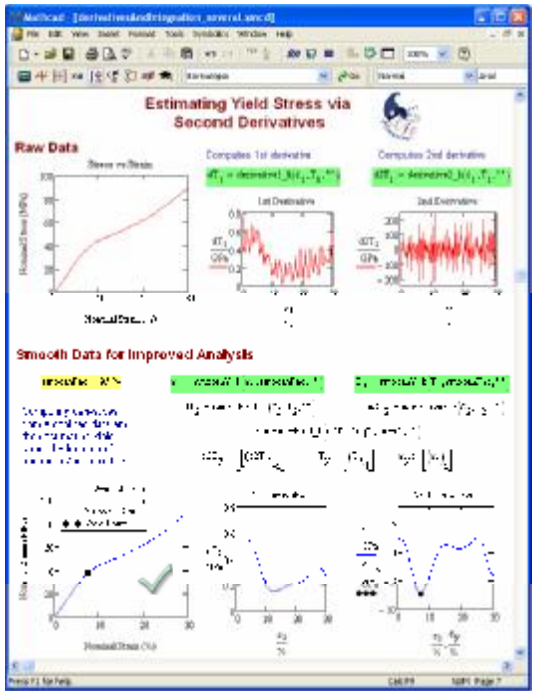
Bodie Technology, Inc

Smart-Tools for Analyzing Challenging Datasets™

Mathcad®

Analyzing Challenging and Noisy Data with Mathcad® and Kornucopia®





www.BodieTech.com

Presenter's Profile – Dr. Ted Diehl

- **Expert in Nonlinear Mechanics with 20+ Years Experience**
  - Experimental, computational, and theoretical approaches
  - Led nonlinear mechanics efforts at Kodak, Motorola, and DuPont
- **Engineering Tools**
  - Mathcad & Kornucopia®, Abaqus nonlinear FEA, and experimental methods
- **Engineering Success in Industry**
  - NASA spacecraft
  - Cell-phone impact
  - Peeling mechanics
  - Paper motion in copiers
  - Simulating fabrics
  - Flexible structures
  - Nonlinear nip mechanics
  - Ballistic protection
  - Nonlinear materials
- **Created unique DSP algorithms**
  - Enhance analysis of noisy data from experiments & Explicit Dynamics FEA
- **Developer of Kornucopia® and President of Bodie Technology Inc.**
  - ***Smart-Tools for Analyzing Challenging Datasets™***

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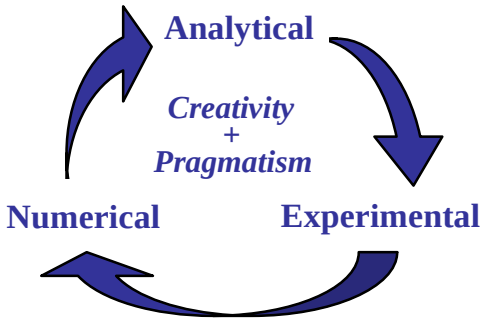
Specializes in solving complex problems in nonlinear mechanics by employing a proven mix of computational and testing knowledge in novel ways



- **Kornucopia® Software**
- **Customized Training**
- **Expert Consulting**

www.BodieTech.com
info@BodieTech.com

Alliances

Our technology will get you moving faster

"Bodie Technology provides engineers with excellent software, training, and consulting resources to help analyze complex nonlinear mechanics problems, especially those involving problematic or noisy datasets."

Steve Levine, Chief Strategy Officer, SIMULIA

Kornucopia®

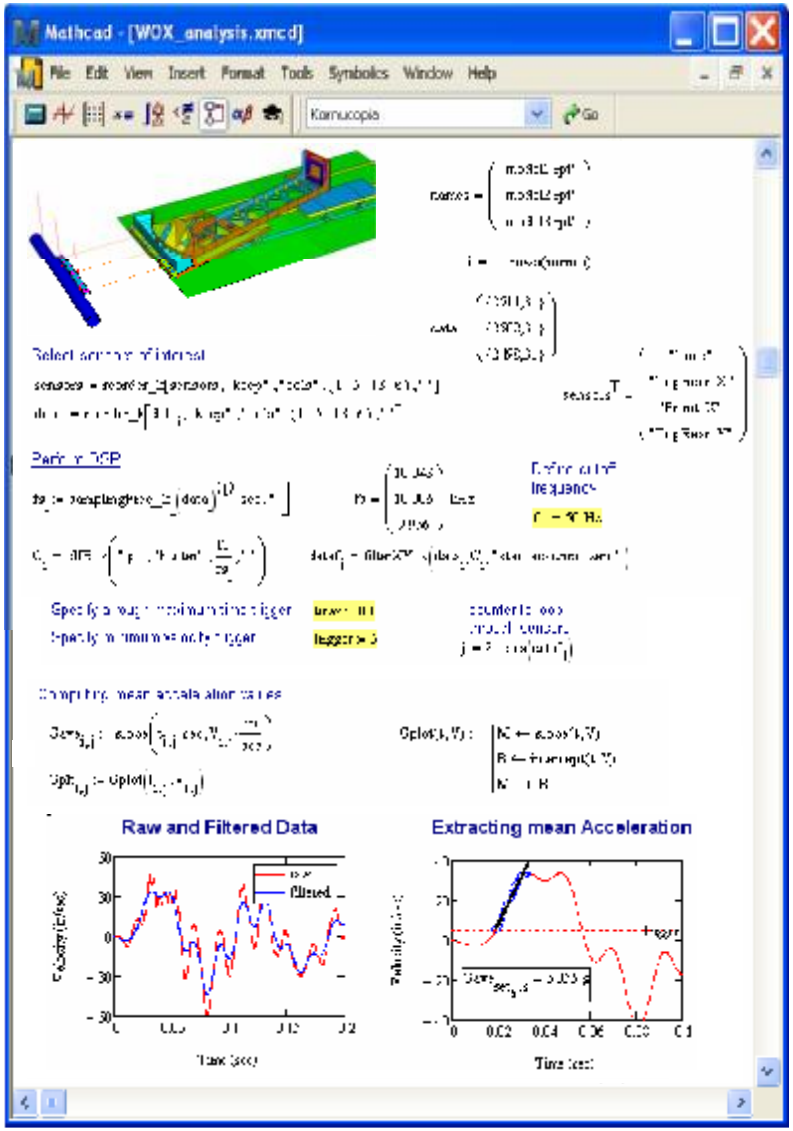
- Powerful software specifically designed to naturally blend the following into reusable, well documented Mathcad® worksheets:
  - Simulation results (FE & others)
  - Experimental data
  - Analytical calculations
  - Algorithms

Cornucopia

- *Horn of Plenty*
- **Abundant supply of various foods**

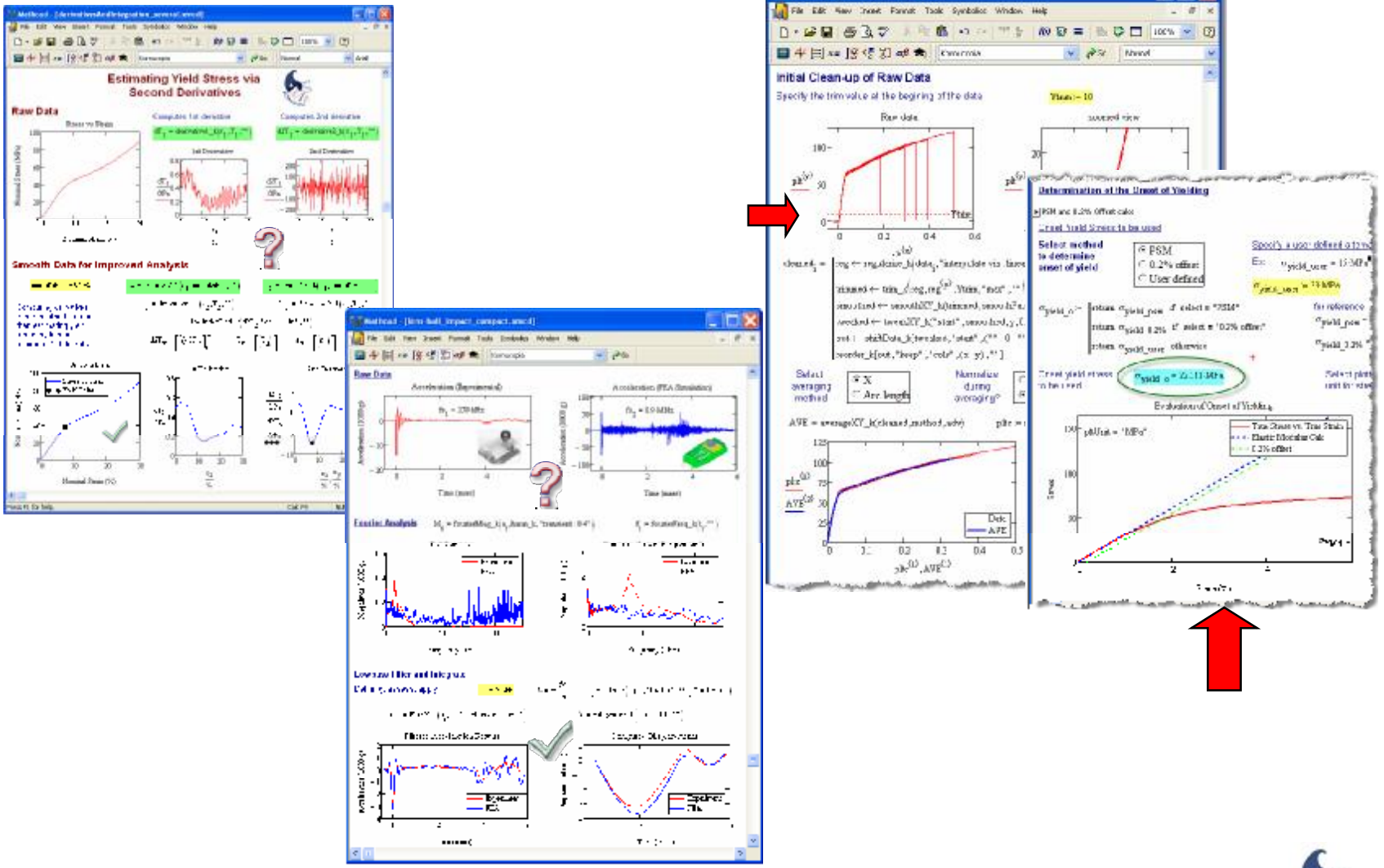
Kornucopia®

- *Horn of Plenty*
- **Abundant collection of functions and templates that makes all sorts of calculations and data analysis faster, more accurate, and easier within Mathcad®**



Analysis of WOX Shock Tester with permission from Jon Yagla, Naval Surface Warfare Center, Dahlgren Div.

Typical Kornucopia® Examples



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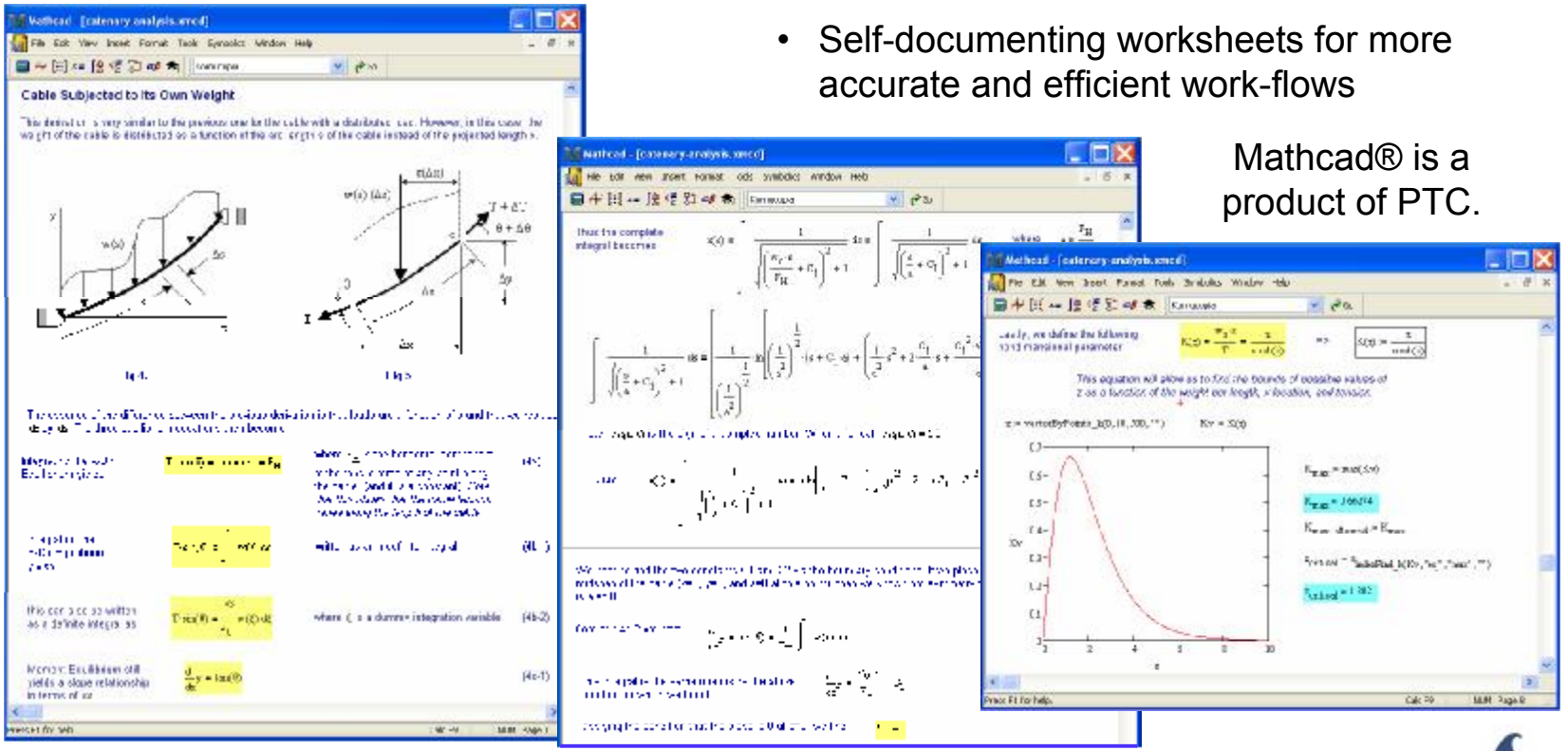
Smart-Tools for Analysis™

Mathcad®

- WYSIWYG scratchpad interface
- Units-aware calculations
- Mix symbolics and numerical methods along with text, images, and graphs

Kornucopia® is built on Mathcad®

- Easy to use programming
- Powerful solve-blocks
- 100's of Functions and Quicksheets
- Many other features
- Self-documenting worksheets for more accurate and efficient work-flows



Mathcad® is a product of PTC.

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Added Functionality with Kornucopia®

85 Functions
30 Templates

Data Adjusting

- Clean-up data via tweaking, trimming, regularizing, padding, rescaling, …
- Create an average XY data curve from multiple curves

Easy-to-use DSP & Filtering

- Powerful DSP tools designed for EVERYONE, not just experts!
- Readily handle data with non-constant sample rates
- Powerful and general purpose Fourier analysis functions
- Frequency Response Functions (FRF)
- IIR & FIR filtering (LP, HP, BP, BS), decimation/upsampling
- Easy-to-use data smoothing (with a simple knob)

Integration and Derivatives

- Work efficiently with large and challenging numerical datasets

Enhanced File Read/Write

- Efficiently unpack files containing multiple data samples repeatedly stacked (with or without headers)

Array and String Manipulation

- Easily rearrange data in arrays and strings, including nested arrays

Cool Stuff

- Create message popup boxes to guide worksheet usage

Example Worksheets & Templates

- Teaching examples & realistic examples applicable to research and industry

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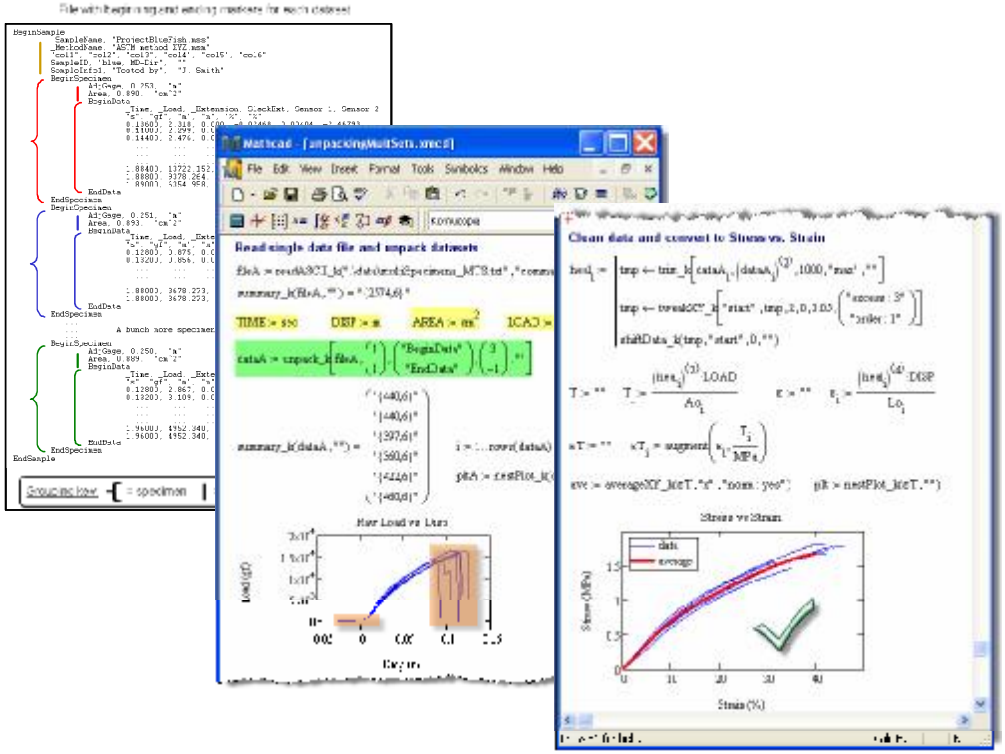
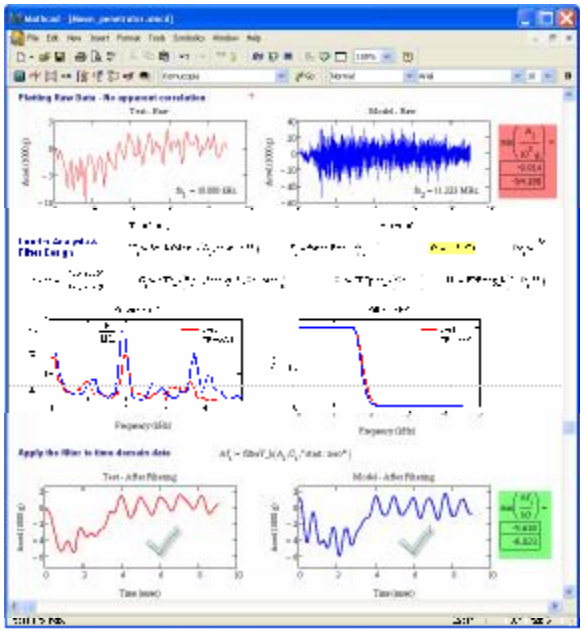
Kornucopia® & Mathcad® Enable Array of Analysis Tasks

Readily Analyze Challenging Data from Measurements and Simulations



Perform Fourier Analysis and Filtering of Noisy Data



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Candidate Users of Mathcad® + Kornucopia®

Anyone working with challenging calculations & data or large amounts of data

FEA Analysts

- Clean and smooth results from noisy explicit dynamics simulations
  - Abaqus, LS-Dyna, Radioss …
- Convert experimental measurements into more accurate nonlinear FEA material laws
- Correlate models/tests faster and better

Experimentalists and Scientists

- Improve efficiency and accuracy when analyzing difficult datasets
- Gain insight into physics of your problem

Process and Design Engineers

- Efficiently/accurately analyze data from facility processes, machinery, product and material tests, engineering calcs ...

Industries

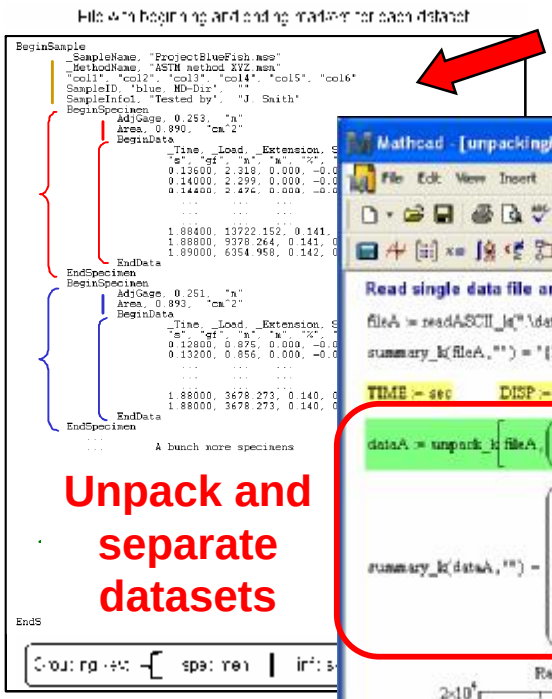
- Aerospace
- Military and Defense
- Automotive
- High Tech, Medical, and Life Sciences
- Consumer Goods and Packaging
- Industrial and Heavy Equipment
- Materials
  - (metals, polymers …)

Typical Uses of Kornucopia®

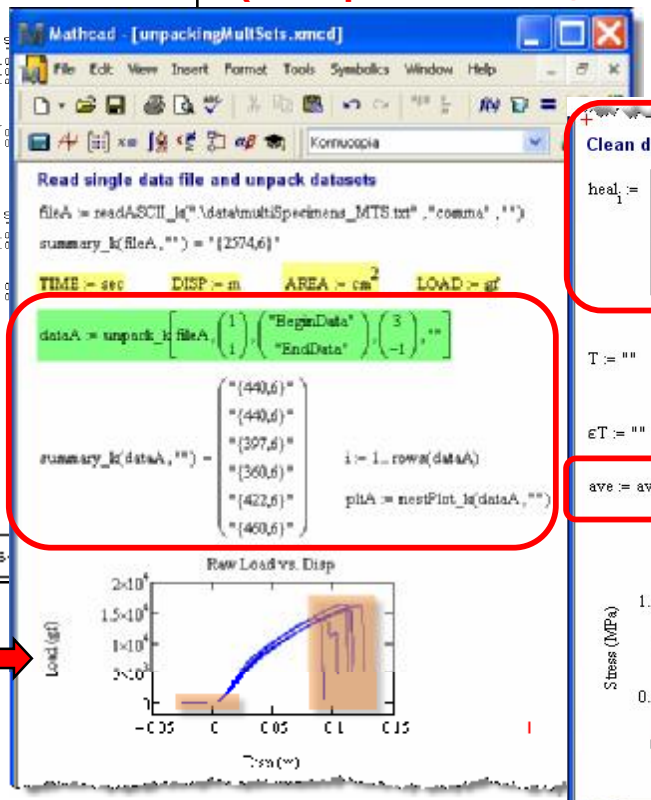
Processing Experimental Data

Reusable, well documented Mathcad analysis worksheet

Challenging data to read
(multiple datasets, header text and data, …)

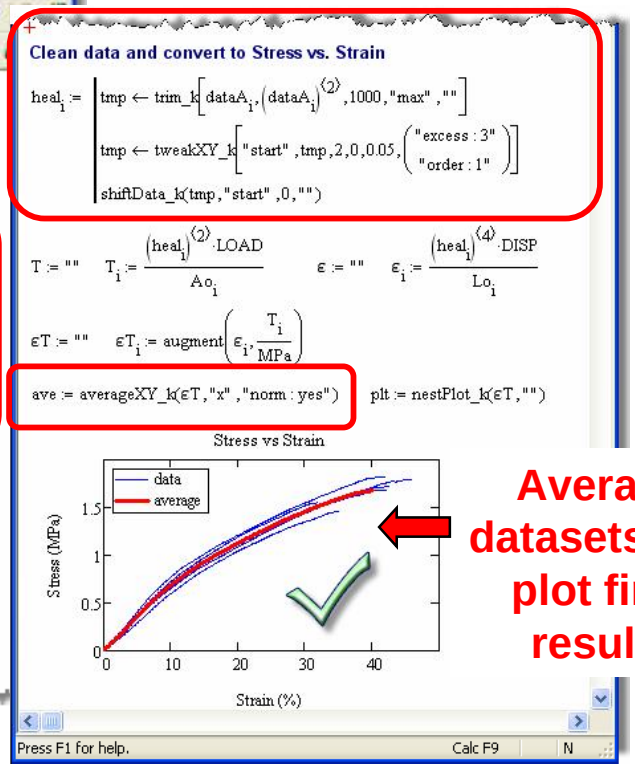


Unpack and separate datasets



Plot raw datasets

Trim & clean datasets



Average datasets and plot final results

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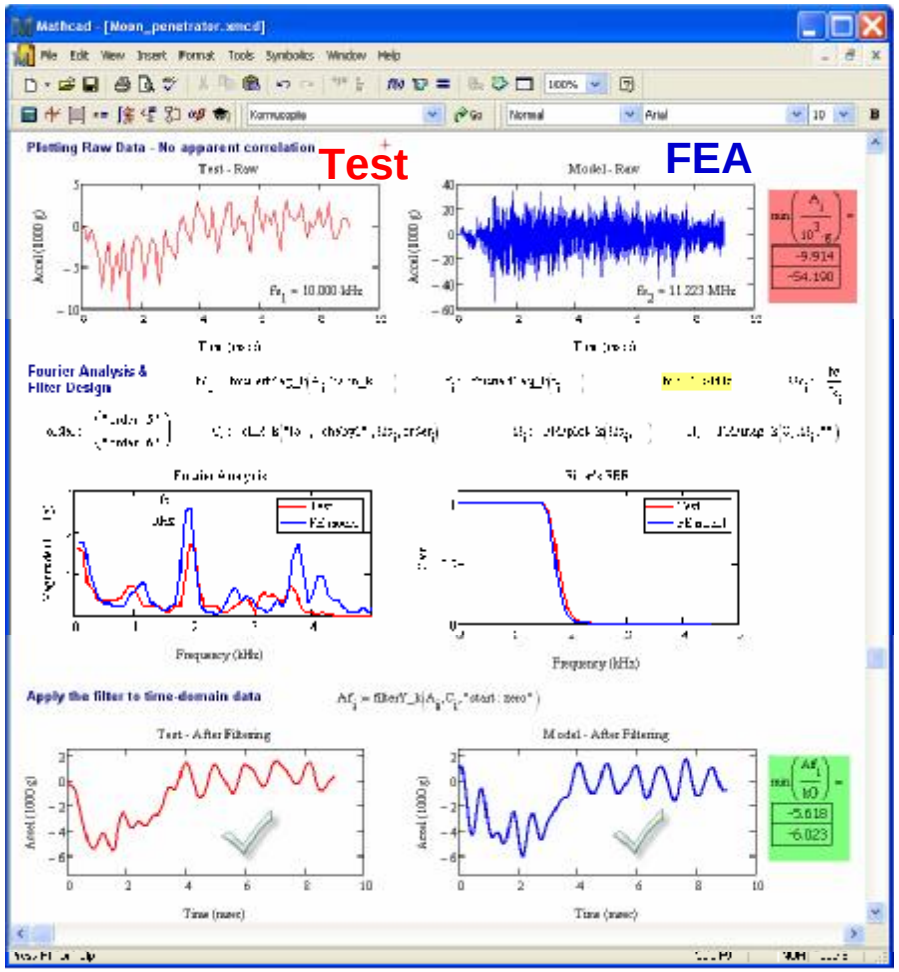
Typical Uses of Kornucopia®

Reusable, well documented Mathcad analysis worksheet

Analyzing Noisy FEA Results and Test Data



Challenging data from a penetration event

- **Initial comparison in time-domain**
- **Fourier Analysis to understand frequency content**
- **Filter to remove higher frequency differences**
- **Reassess filtered data in time-domain**

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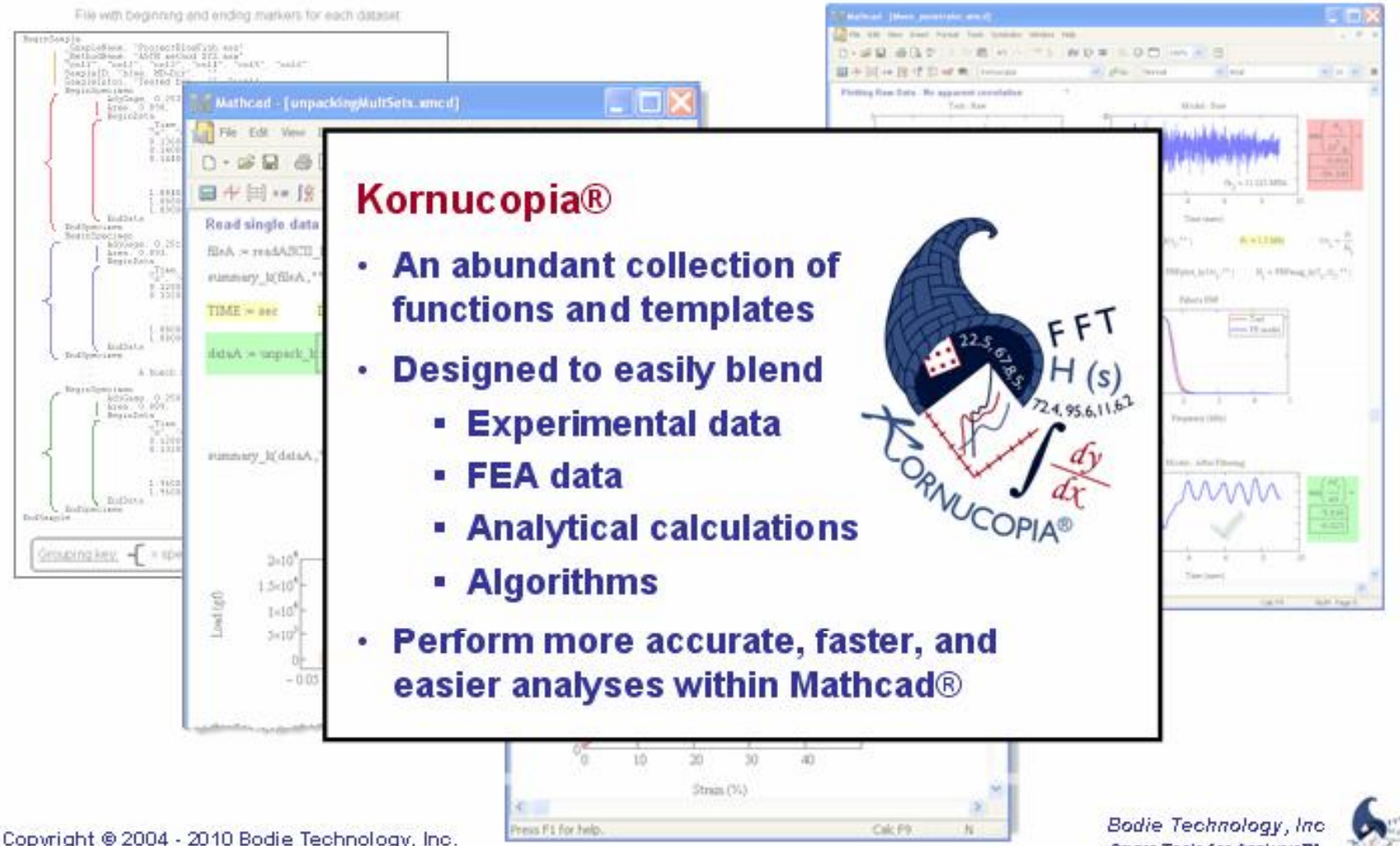
Typical Uses of Kornucopia®

Processing Experimental Data

Analyzing noisy FEA and Test Data



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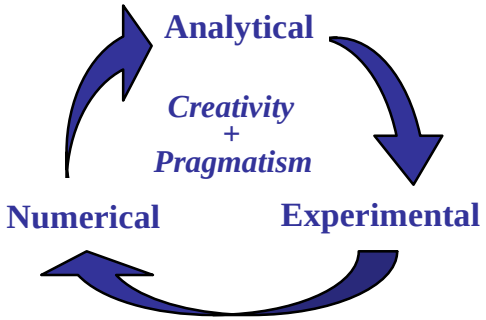
Powerful Tools Efficiently Drive Engineering Decisions

Mathcad + 

⇒ 

"Without Kornucopia® I really doubt the quality and quantity of work would have been what it was."

Lieutenant Colonel Kelly Laughlin, PhD
US Army, Picatinny Arsenal

Analyzing ballistics from both Explicit FEA & tests

"We congratulate the Kornucopia® development team for creating such an effective and simple-to-use toolkit for engineers worldwide."

Arun Nair, Ph.D.,
Becton Dickinson & Co - CAE Group

"Kornucopia® has helped greatly in breaking down difficult data sets from experiments, in an easier, automatic, and understandable way. This has helped us setup, scrutinize and understand the experiments faster, which is priceless… It helps make the organization move faster…"

David McCalib
Blount International, Mfg. Engineer

Examples

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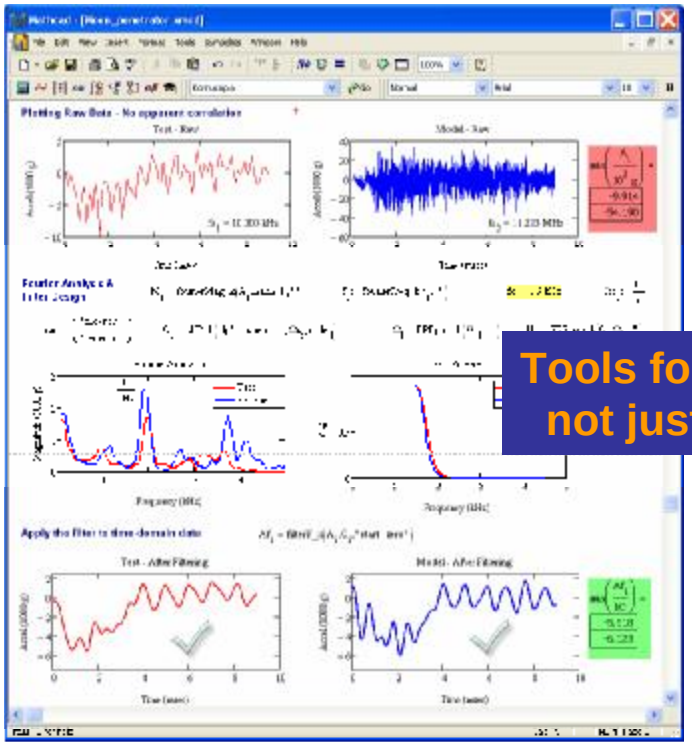
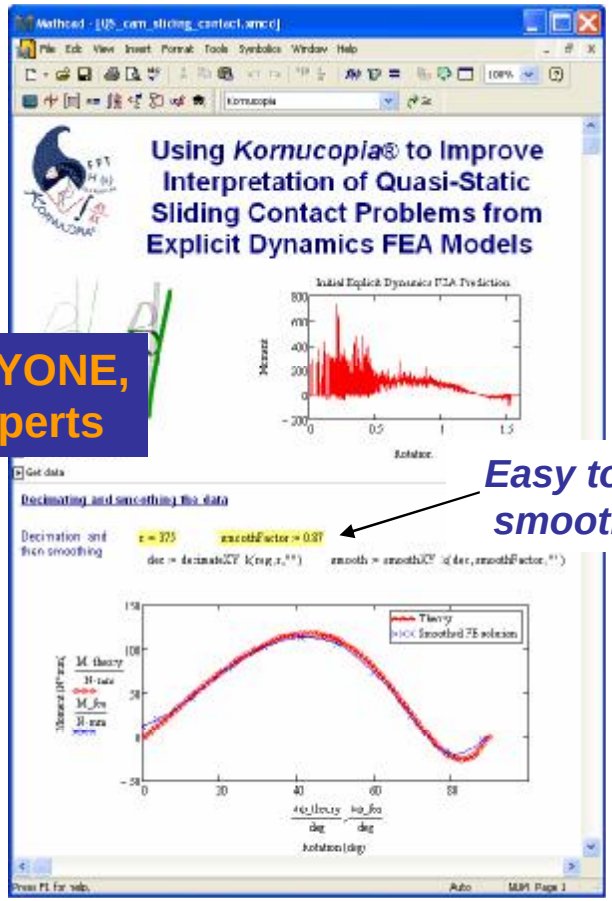
Kornucopia has Powerful, Yet Easy-To-Use Features



Tools for EVERYONE, not just the experts



Easy to use smoothing

DSP features

- **Fourier Analysis (FFT)**
- **Filtering - FRF plots, LP, HP, IIR, FIR …**
- **More!**

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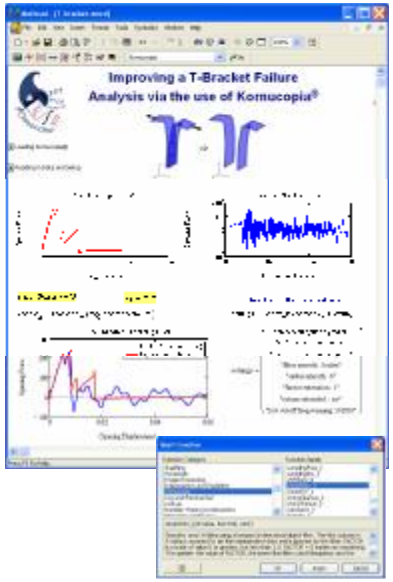
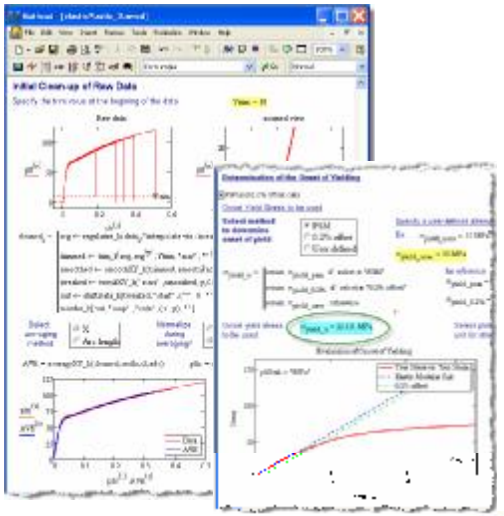
Benefits of Mathcad® + Kornucopia®

- Single environment for analyzing data from many sources
  - Experiments, Simulation Results, Analytical Calculations, …
- Intuitive work-flows for challenging datasets commonly found in engineering and science
- Analyze data accurately, yet pragmatically
  - ✓ Heal non-ideal datasets via reorder, trim, smooth, tweak ...
  - ✓ Powerful DSP tools designed for EVERYONE
  - ✓ Enhanced data interpretation
  - ✓ Do more with less effort
- Improved correlations between models and tests
- Enables automation of work-flows
- Kornucopia® is backed by Unique Training and Expert Consulting from Bodie Technology Inc.





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- more videos: www.BodieTech.com/videos

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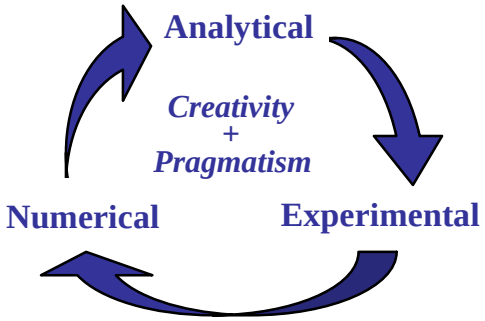
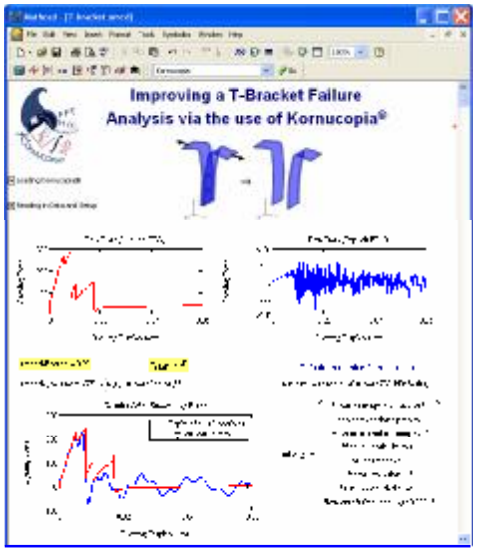


Our technology will get you moving faster



- **Kornucopia® Software**
- **Customized Training**
- **Expert Consulting**

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