

The logo consists of the text "31ST" in white, enclosed within a white square border. The background of the entire graphic is a dark blue gradient with a subtle, light blue geometric pattern of interconnected dots and lines, resembling a network or molecular structure.

31ST

RESEARCH SYMPOSIUM

26 - 30 June 2023

Greater Columbus Convention Center
Columbus, OH

ASNT | **EVENTS.**

Open-Source NDE Simulation and Data Processing Tools from NASA

Elizabeth Gregory

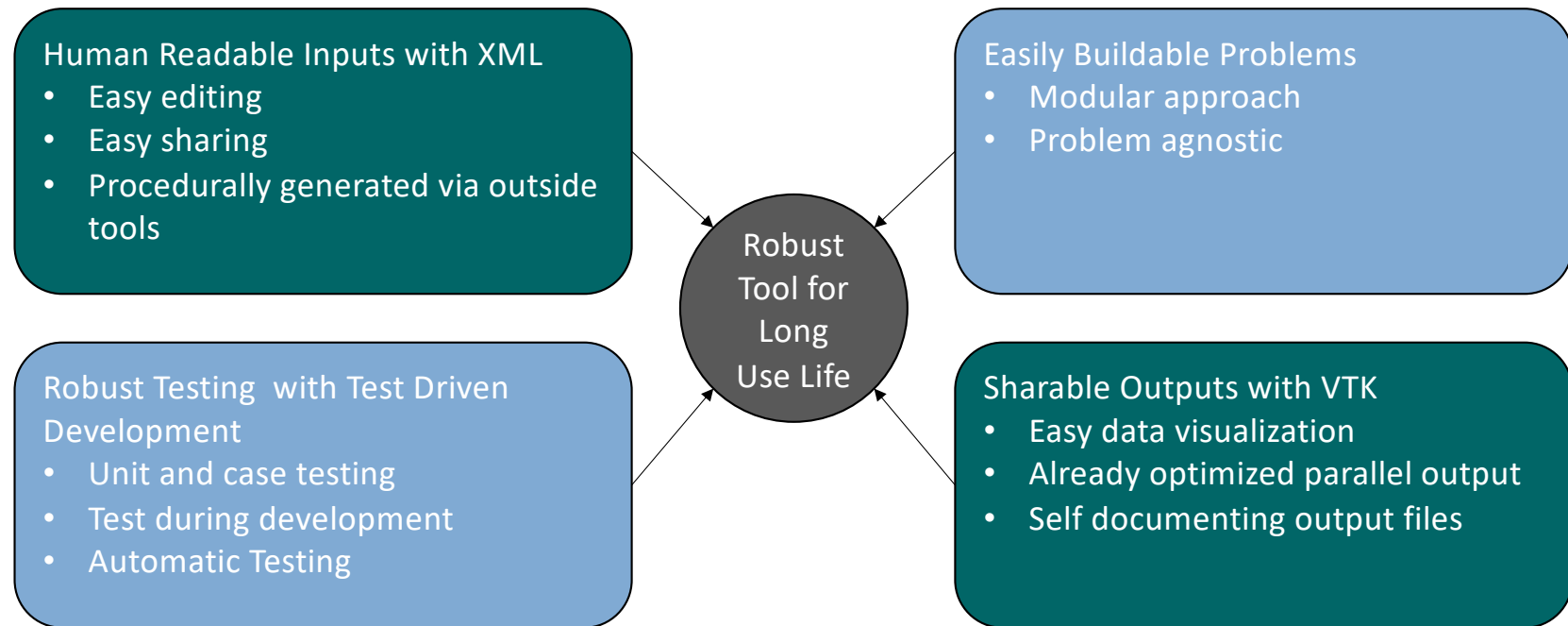
Bill Schneck

NASA Langley Research Center

 **RESEARCH SYMPOSIUM**

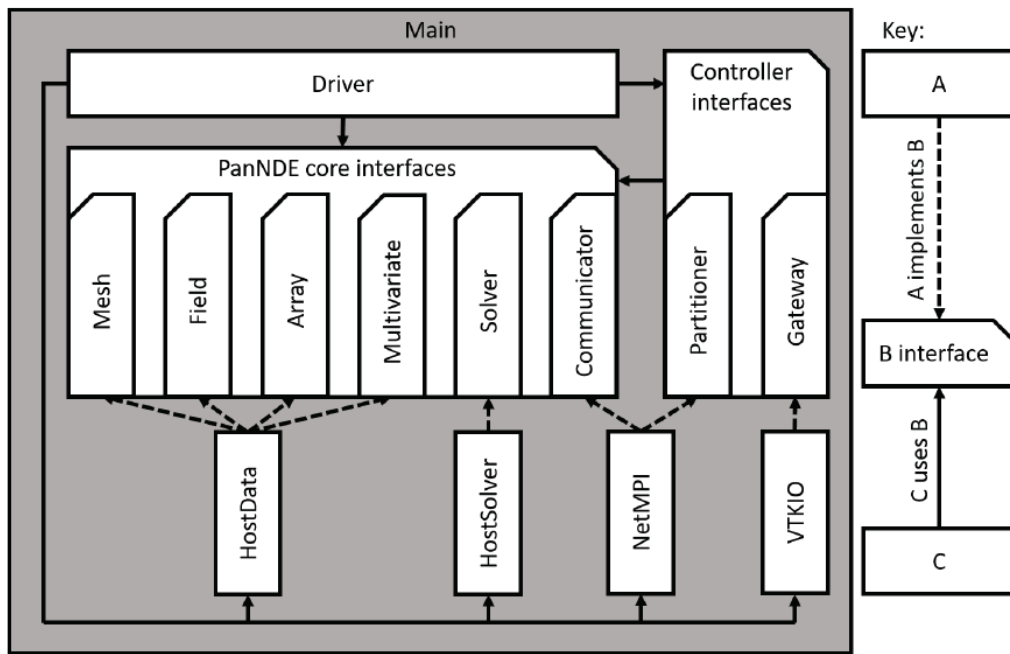
ASNT | **EVENTS.**

Goals for Open-Source Software



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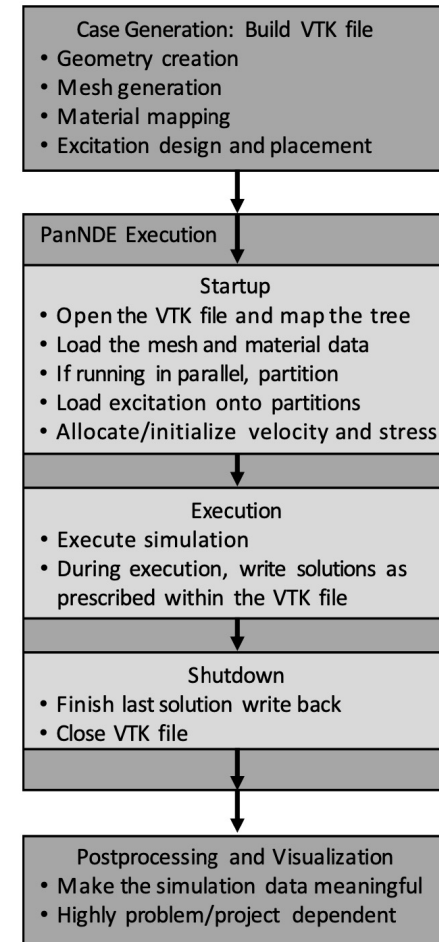
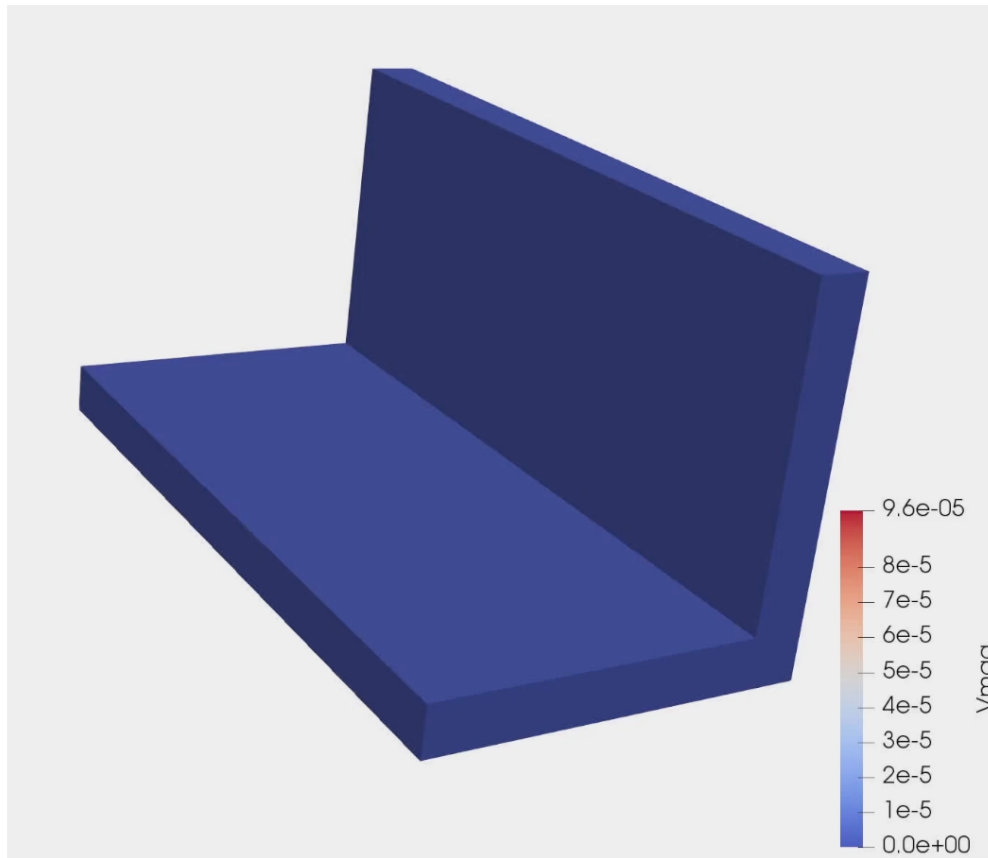
PanNDE: Open-Source Toolbox for NDE Simulation



1. R. Martin, Clean Architecture: A Craftsman's Guide to Software Structure and Design, Prentice Hall, 2018.
2. O'Connell, Matthew, et al. "Application of the Dependency Inversion Principle to Multidisciplinary Software Development." 2018 Fluid Dynamics Conference. 2018.<https://doi.org/10.2514/6.2018-3856>

- Emphasis on^{1,2}
 - delineation between components (e.g. single responsibility principle)
 - interconnection between components (dependency inversion)
- Influence of modularization:
 - Extensibility (e.g. physics solved is 'just another module')
 - Maintenance of independent components
 - Reduction in technical debt
- During development:
 - Encapsulation of MPI reduced overhead of testing and maintenance
 - Insulation from I/O library allowed pivoting from CGNS to VTK
 - Modularization allowed porting mesh and I/O modules to another project

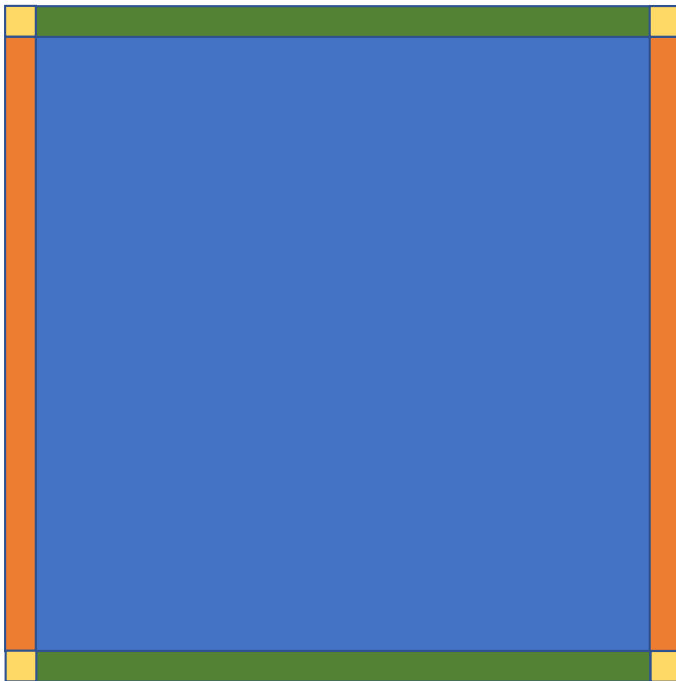
Example Simulation



PanNDE 2.0 Additions/Changes

- Groups: Easy creation and selection of subsets of geometry. Allows users to:
 - Easily implement their own boundary conditions.
 - Save output for only Regions of interests.
- Dakota Hooks for meta-analysis.
- Thermal Model Solver Example.
- New UT Source Examples.
- New Included Python Tools
 - Case makers for fast creation of input files.
 - Metallic
 - Composite
 - Post processing scripts
 - Example for the python VTK bindings.
- Better Data Handling
- General Refinement

Groups – A infinitely sized plate with a Perfectly matched Layer Boundary Conditions



- Blue Group - Normal Computational region
- Orange Group PML for X direction.
- Green Group PML for Y direction
- Yellow Group PML for X & Y directions

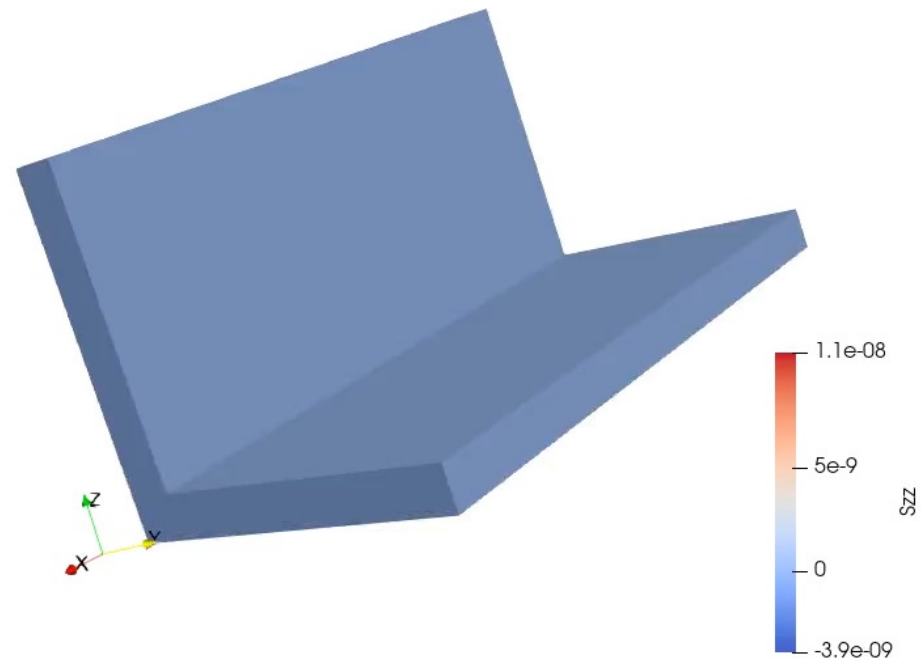
Composite Laminate Example with transducer input

- Example for
 - python case maker
 - material property rotations
 - transducer input



Aluminum Angle Bracket

- Example for
 - python case maker
 - Lamé parameters
 - 6x6 stiffness matrix
 - Water column input



Example: Porosity in Additively Manufacture Parts

- Porosity is randomly generated. Size and location.
- Uniform pulse source.
- Compared attenuation.
- NDE&T Article is forthcoming.

