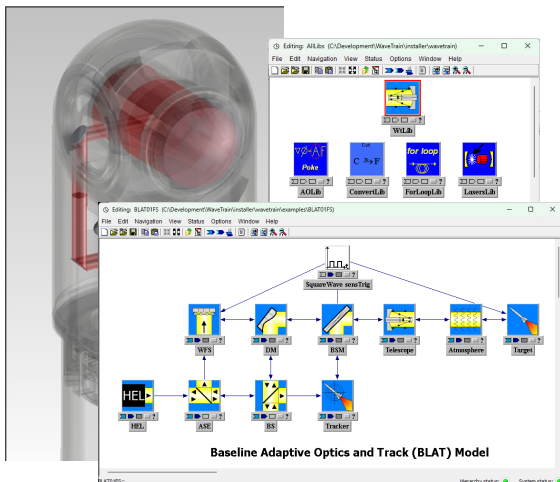




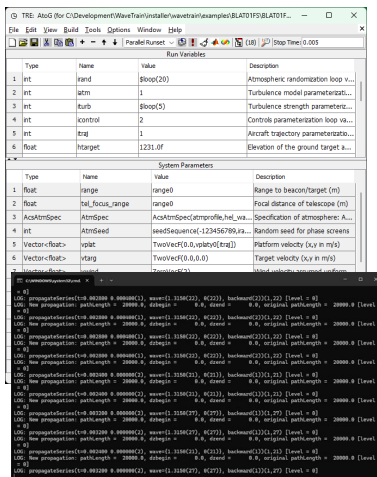
WaveTrain – wave optics made easier

Wave optics simulation is a crucial technology for the design and development of complex, advanced optical systems. Simple wave optics propagations can often be simulated with custom application of the relevant numeral equations. However, integrating a full representation of hardware including platform/target dynamics, sensors, adaptive optics (AO) & tracking, control logic, etc. can be a daunting task. This is where WaveTrain shines, putting the power of wave optics system simulations at your fingertips. Through an intuitive connect-the-blocks visual programming environment, you can assemble beam lines, control loops, and complete system models, including closed-loop AO systems.

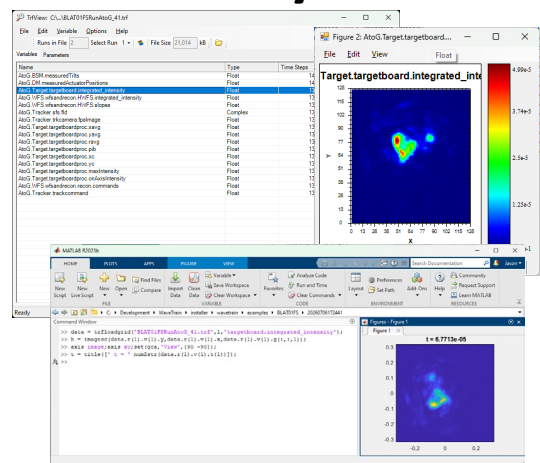
Design



Execute

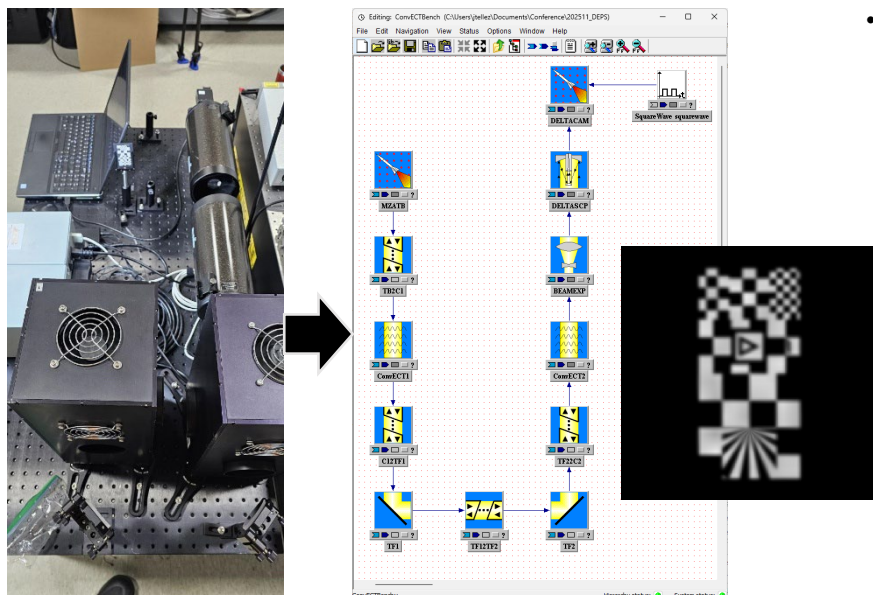


Analyze



Isomorphism in WaveTrain

WaveTrain atomic components can be grouped together creating a system of systems with functionality representing your real-world hardware. This creates a near one-to-one mapping of components from the system design to WaveTrain simulation to hardware. Custom, third party software can be easily integrated into a WaveTrain component enhancing the effectiveness of the simulation. The example below is a bench layout of a DELTA system imaging through two ConvECT turbulence generators.



System Requirements

- Windows
 - Visual Studio C++ Compiler
 - MATLAB (recommended)
 - Note: Visual Studio Build tools with the C++ Compiler and MATLAB Runtime Libraries provide enough functionality to execute simulations. However, WaveTrain analysis is best done in MATLAB (Python Utilities are expected in late 2026) and building components with custom code and debugging is greatly simplified with a full version of Visual Studio.
- Linux (Tested on RHEL 9+ and Ubuntu 24 LTS)
 - GCC 11.5 or greater
 - CMake
 - Open MPI
 - MATLAB (recommended)

4900 Lang Ave. NE, Suite 100
Albuquerque, NM 87109
505-245-9970

1360 Technology Ct, Suite 200
Dayton, OH 45430
937-684-4100



WaveTrain Concourse

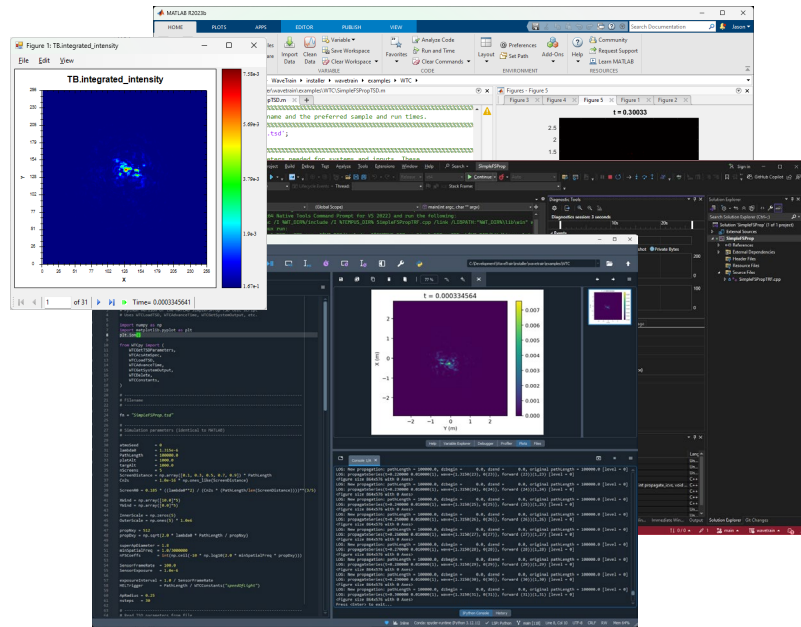
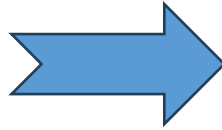
WaveTrain

wave optics made easier

MZA API Support
Dynamic Build



Platform Toolboxes
MATLAB / Python



WaveTrain v2025A includes a new way of building, executing, and interacting with a WaveTrain simulation called WaveTrain Concourse (WTC). WTC takes advantage of MZA's Application Programming Interface (API) support library, which when combined with a dynamic build process allows a user to put together the simulation with a simple set of platform toolboxes. This allows an engineer to integrate a WaveTrain simulation into whatever existing simulation environment the engineer is already familiar with. WTC includes examples using C/C++, Python, and MATLAB. Currently WTC includes high level wrappers, using the existing Tempus System Description and Runset formats, for MATLAB with Python wrappers available in late 2026. When executing a WTC simulation, the user can increment the Universe, extract the current state of the simulation for display/monitoring, and make changes to inputs before advancing to the next time step. This allows developers to test their Adaptive Optics, Tracking, Fire Control, or other algorithms in their preferred environment using wave-optics generated data providing feedback on the algorithm's effectiveness.

