

## Xilinx Alveo powers ThunderEnergy

### INTRODUCTION

Seismic tomography technology is widely used in oil and gas exploration. Full-waveform inversions (FWI) have become applicable to today's large seismic data sets. 3D inversion is still a major computational challenge, the emergence of large heterogeneous high-performance computing (HPC) systems has the potential to transform full-waveform inversion into a widely used routine method. DeePoly Technology's ThunderEnergy leverages the Xilinx® Alveo™ Data Center Accelerator card to accelerate the FWI algorithm and get a 50% performance boost compared with GPU acceleration.

### KEY BENEFITS

- Speed - 1.5 times compared to GPU solutions
- Energy efficiency - 4 times better than GPU solutions
- Analysis cycle - 33% reduced compared to GPU solutions

### SOLUTION OVERVIEW

Figure-1 shows the processing architecture of ThunderEnergy

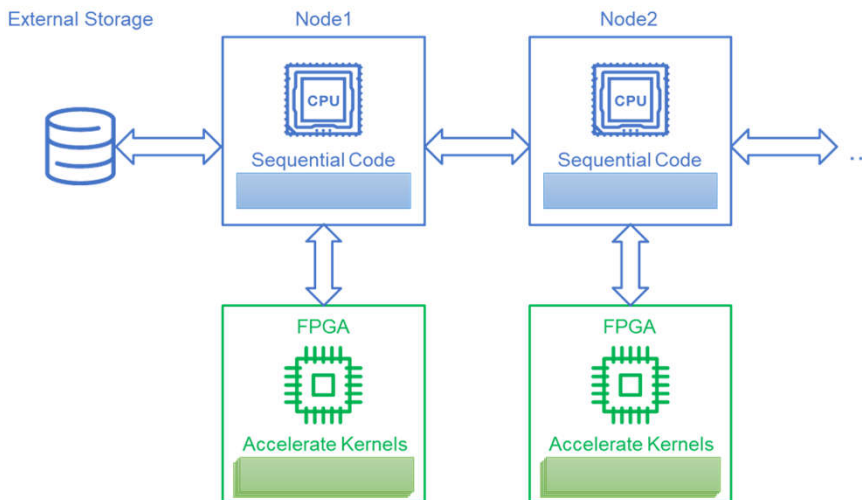


Figure-1

### SOLUTION BRIEF



- 4x Higher Power Efficiency
- 50% Higher performance
- Ultra-Low latency

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### SOLUTION DETAILS

ThunderEnergy accelerates the FWI algorithm using a well-designed architecture:

Each program instance consists of a sequential part running on the CPU core and a massively parallel part running on the Xilinx Alveo FPGA.

- The sequential part includes modules for application initialization, inter-node communication, mass storage I/O, and management of control and data flow for operations offload to the FPGA.
- The massively parallel part is represented as a set of FPGA kernels that reside and run on FPGA, each kernel implementing a certain computational function.

The sequential part orchestrates the activation of FPGA kernels. FPGA kernels perform all computations of the SES3D time step algorithm, including the computation of external forces, velocity gradients and stress rates and the time extrapolation of stresses and velocities. Furthermore, there are kernels implementing functionality specifically for various computation modes.

### RESULTS

Key results comparison among unaccelerated and accelerated compute nodes (Normalized)

Item	CPU	CPU+GPU	CPU+FPGA
Performance	1x	4x	6x
Energy Efficiency	1x	2x	8x
Analysis Completion (t)	1x	0.25x	0.17x

### TAKE THE NEXT STEP

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