

Acceleration Of Transverse Waveform Relaxation Using Waveform Compression

by

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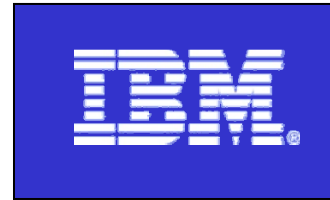


Outline

- Introduction
- Waveform Relaxation
 - How It Works
 - C++ Implementation
- TWR Bottleneck
 - Source Updating
- Waveform Compression
- Results
- Conclusions

Introduction

The work presented in this article is the result of a collaboration between:



aimed to explore parallel computation for circuit simulation.

The Waveform Relaxation

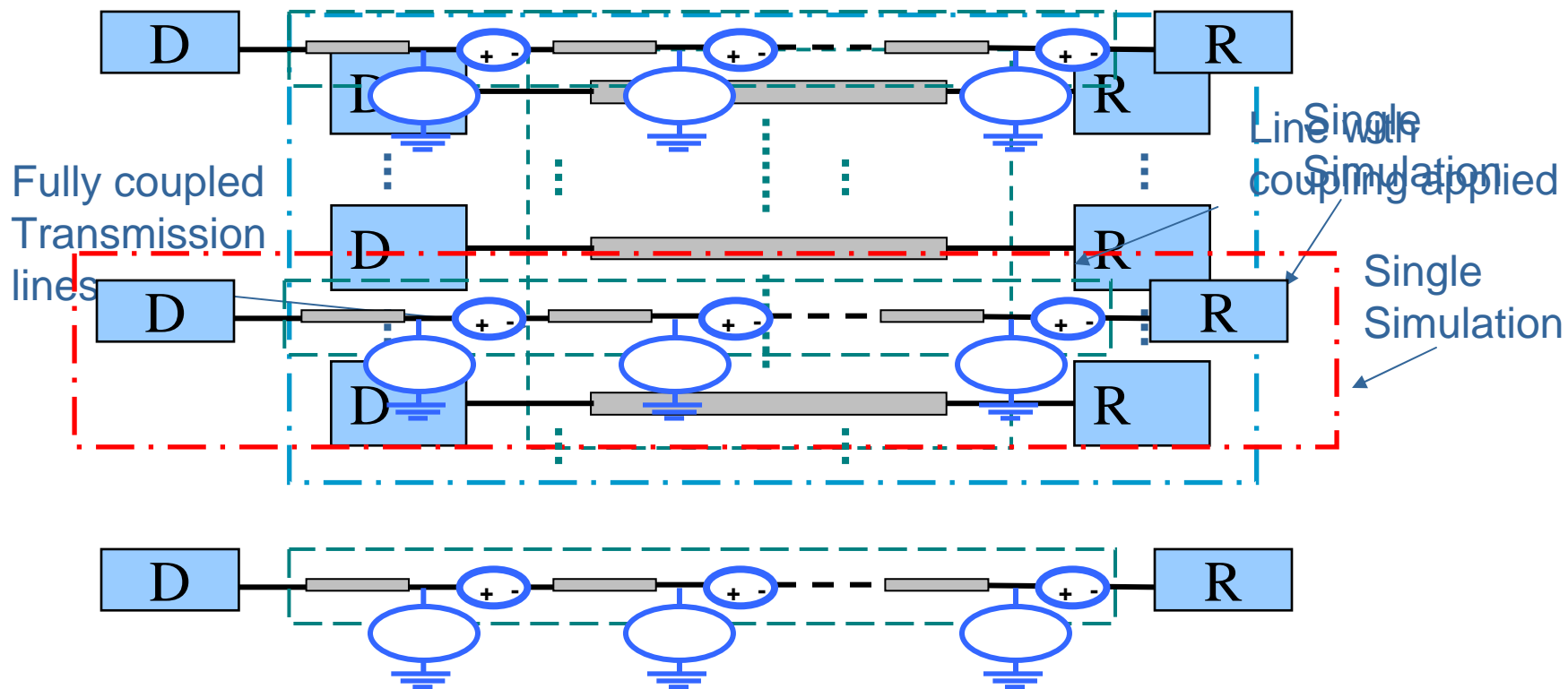
The parallel calculation can be applied in the simulation of Multiconductor Transmission Line (MTL) using the Transversal Waveform Relaxation (TWR).

The method is described inside the article:

“Simulation of Coupled Interconnects Using Waveform Relaxation and Transverse Partitioning”

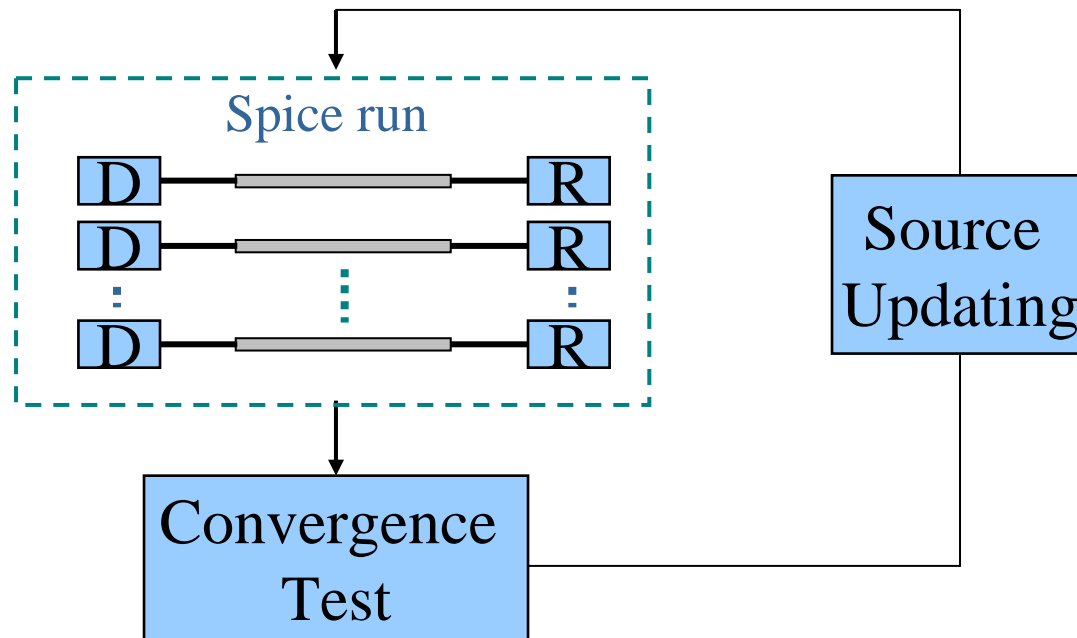
by Nakhla, Ruehli, Achar

How TWR Works



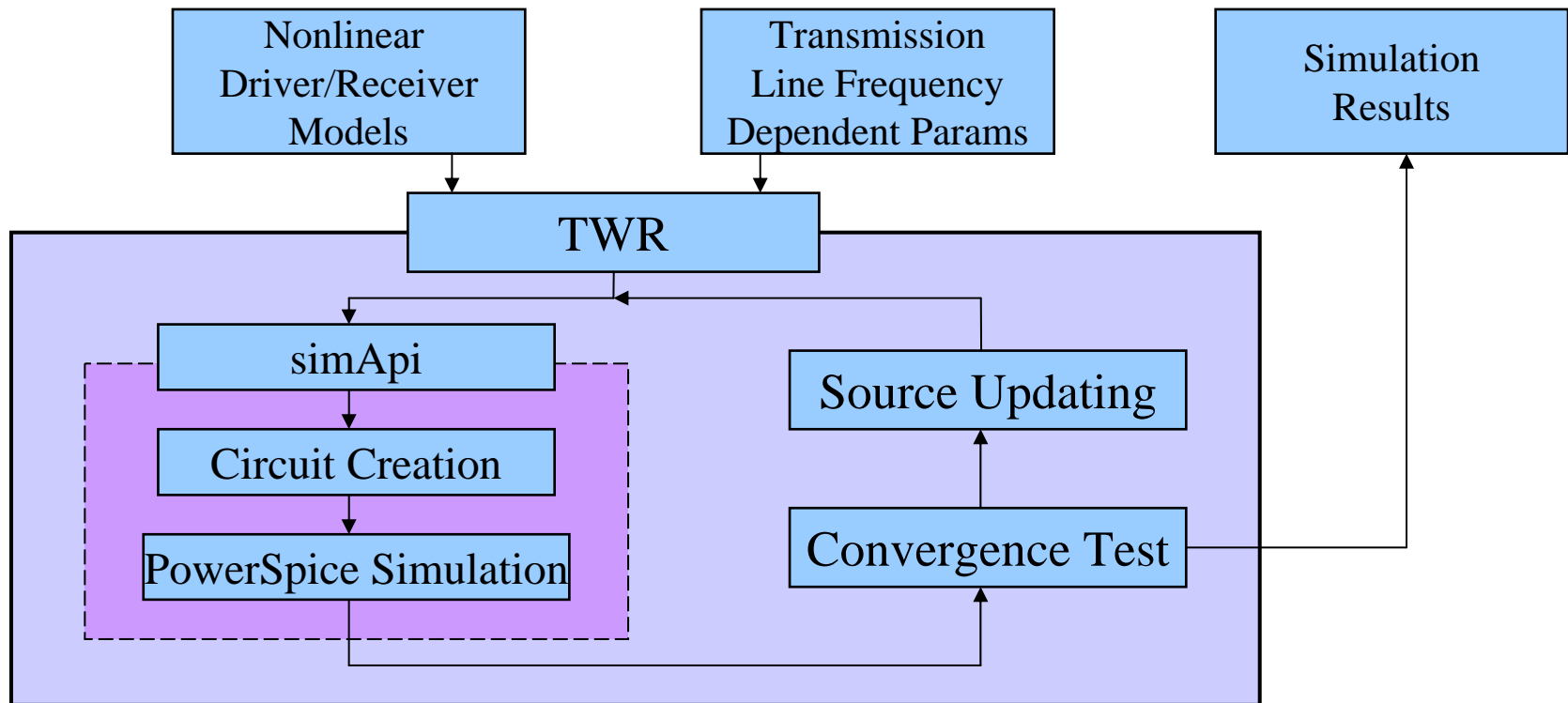
TWR Iteration

TWR method is based on iterative refinement of the solution. At every iteration the coupling sources are updated using data from the previous iteration.



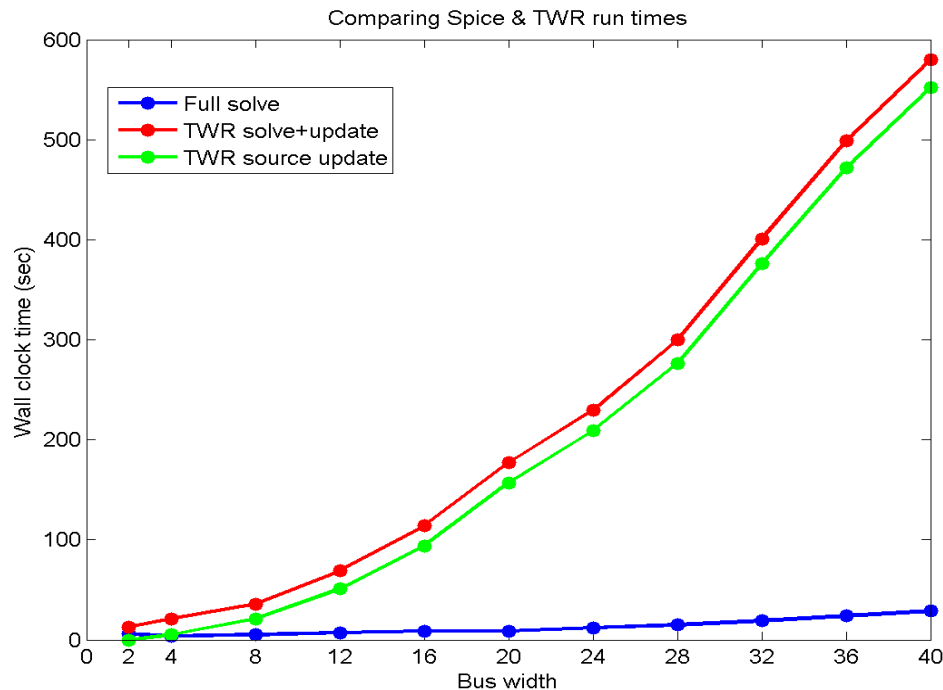
The TWR Implementation

The developed C++ program implementing TWR has the following diagram

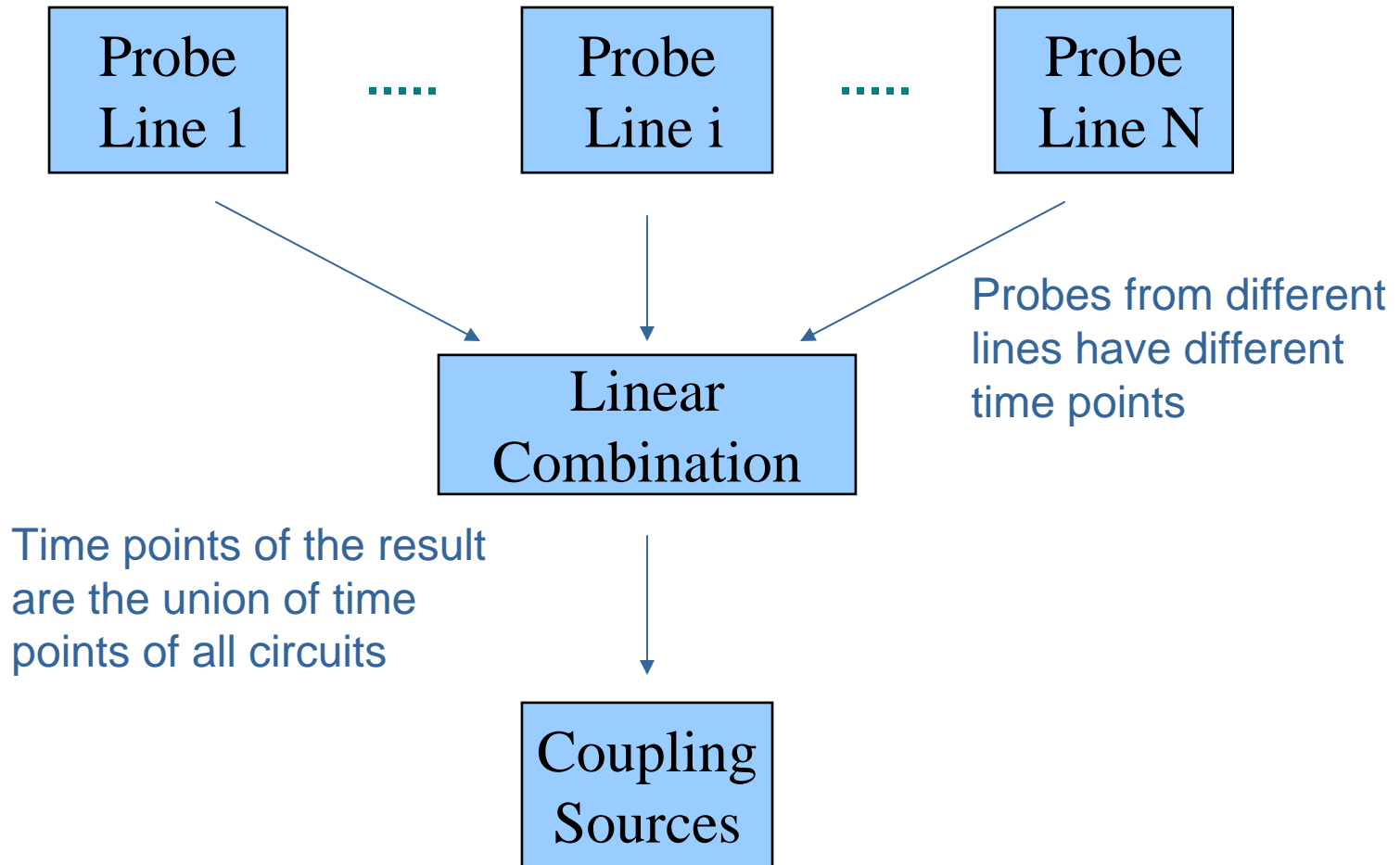


TWR Bottleneck

Analyzing the TWR performances with simple drivers (generator + resistance) and loads (capacitor) we observed that almost the time was used for the source updating procedure.



The Source Updating



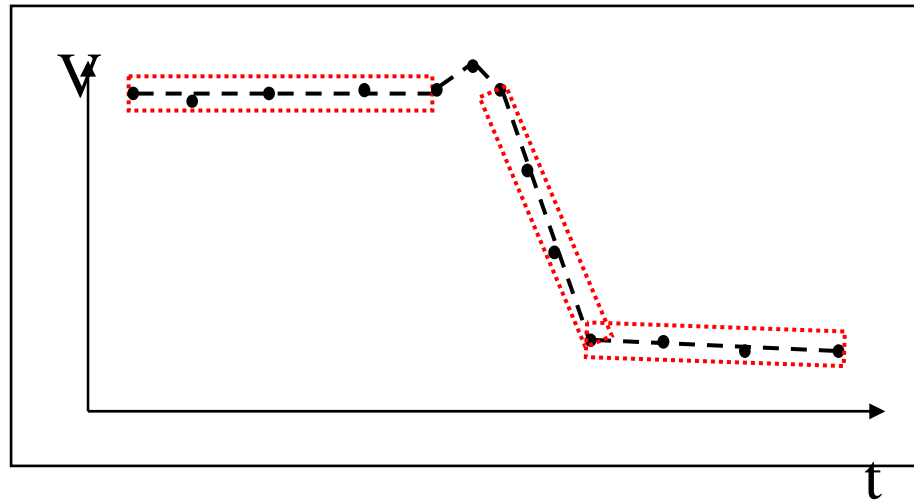
Source Updating Unefficiencies

- Coupling Sources increase the number of time points used during simulation
- The Source Updating performance depends on the number of waveform time points and lines
- Coupling Sources have a number of time points that is the union of time points of all waveforms, then more lines means more points
- Coupling Source dimensions affect simulation efficiency

Keeping the number of point as small as possible is a key factor to have good performance.

The Waveform Compression

The principle : Digital Waveform have predictable shapes. Compression remove time-value pairs unnecessary for the waveform description



Why Using Waveform Compression?

Waveform Compression has the following effects:

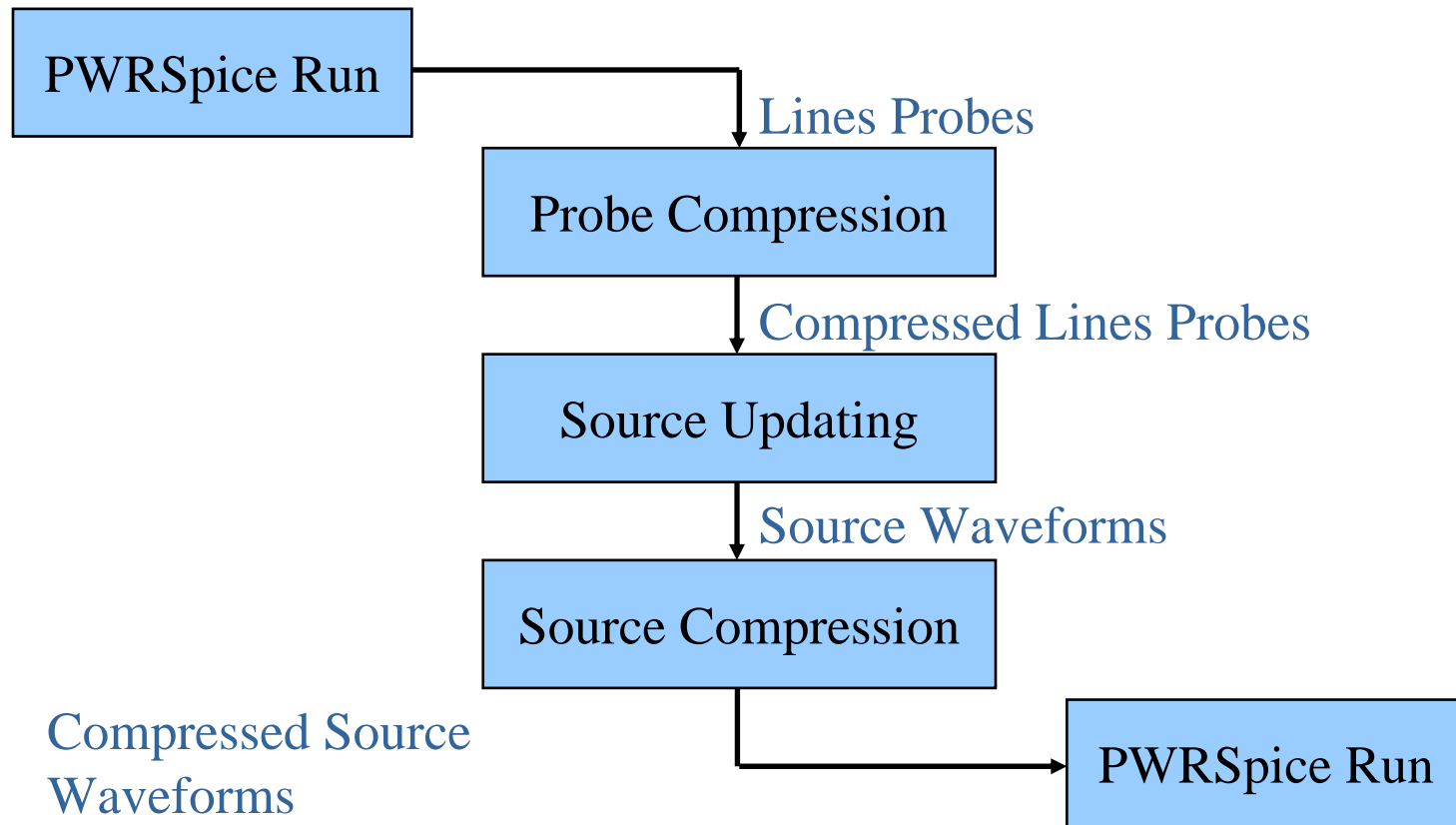
- Increases the Source Updating efficiency
- Reduces the amount of memory used
- Reduces the influence of Coupling Source on circuit simulation

Where Using Waveform Compression?

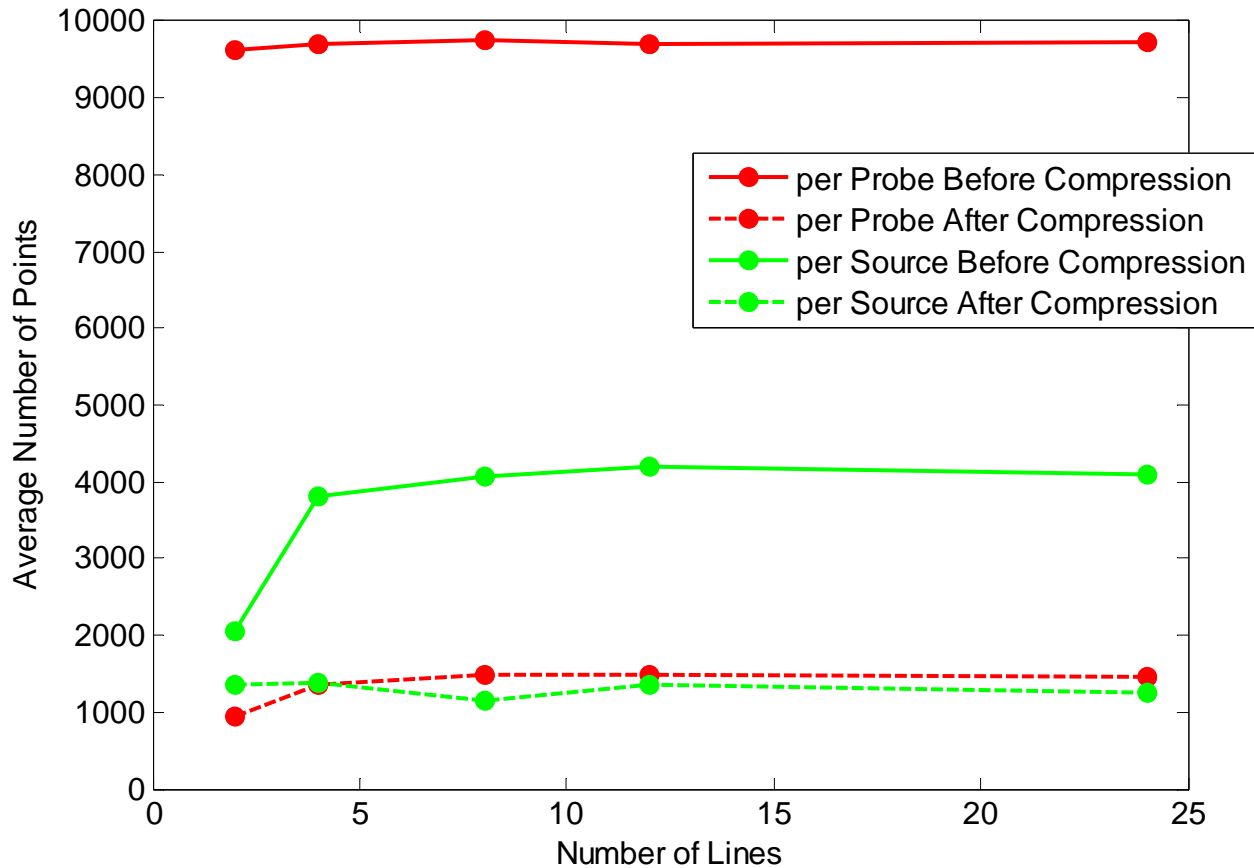
Waveform Compression has to be used:

- Before the Source Updating to increase its efficiency
- After the Source Updating to increase the simulation efficiency

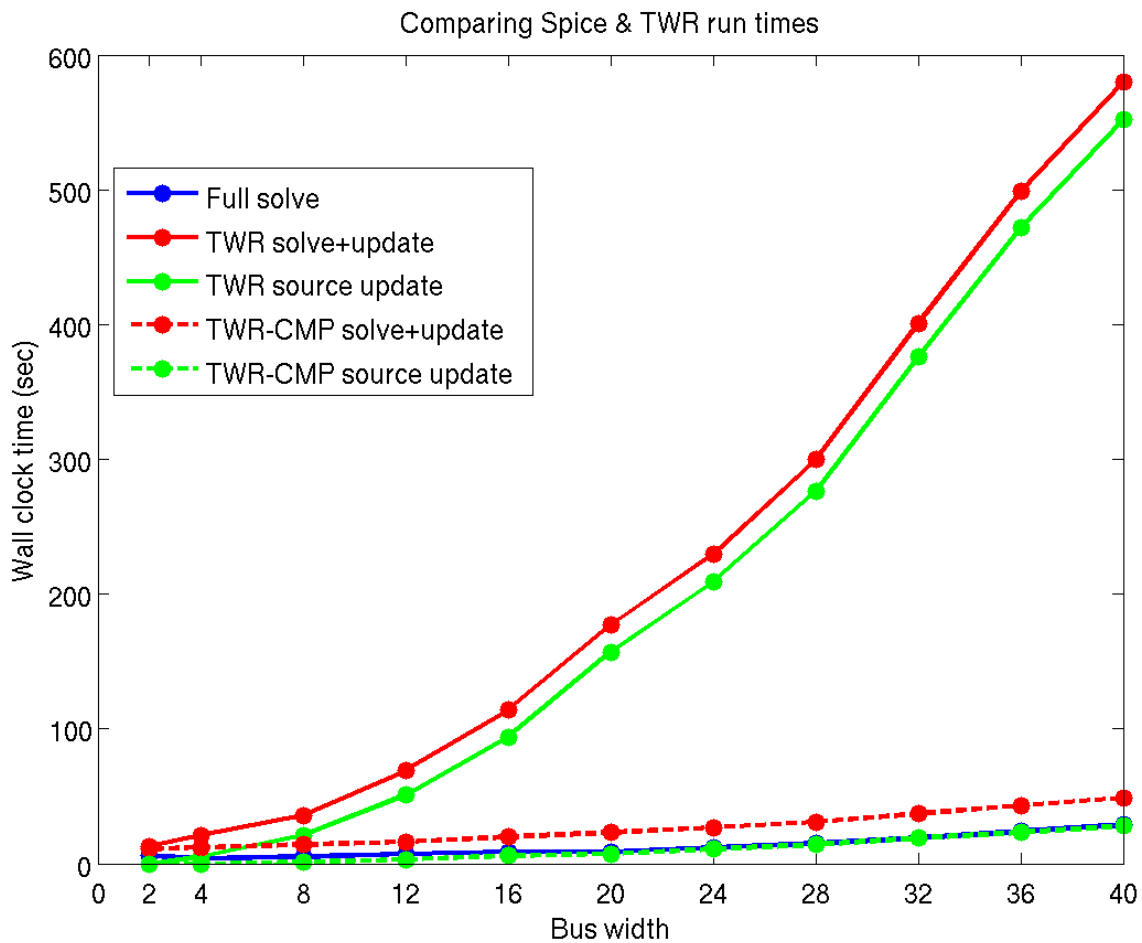
TWR with Waveform Compression



Waveform Compression Performance



TWR Performance



Conclusions

- The Waveform Compression solves TWR bottleneck
- It improves TWR speed and reduces the amount of memory requested by the algorithm.
- The Waveform Compression can be easily added with few modification to the standard TWR algorithm.
- It can be implemented using library aimed to process analog waveforms

Thank You

Questions?

