



Extensible PC-Cluster based workbench for testing of Protective and Controlling Equipment



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Applications

- Operator Training
- Real-Time equipment tester Relays & Controllers

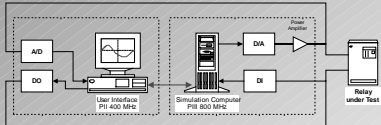
Studies Capabilities

- Evaluation of protective schemes
- Switching & Faults

Advantages of PC architecture

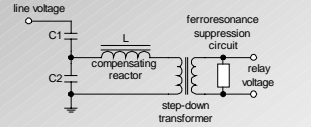
- High portability
- Low maintenance & operational costs

Real Time Relay Testing System Architecture

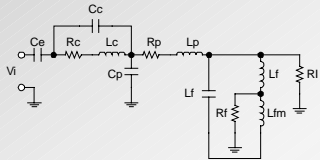


• Coupled-capacitor voltage transformer (CCVT)

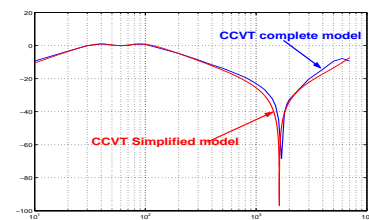
CCVT circuit



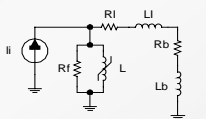
Equivalent circuit for the CCVT



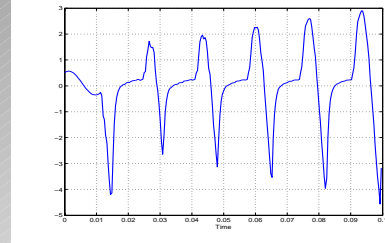
CCVT Frequency Response



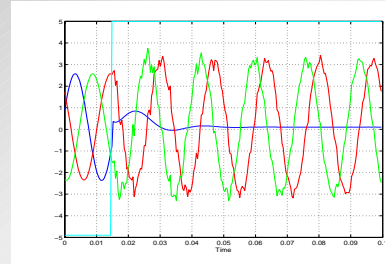
• Current transformer equivalent circuit



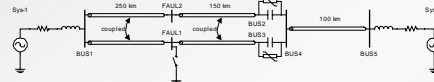
Saturation effect due to current transformer



Faulted Voltage through a CCVT



Benchmark

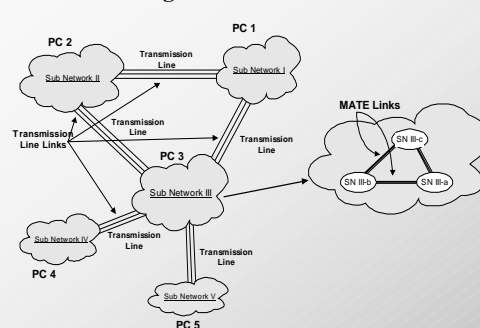


- 33 nodes
- 2 six-phase transmission lines
- 1 three-phase transmission line
- 2 source equivalents
- MOVs
- CCVTs

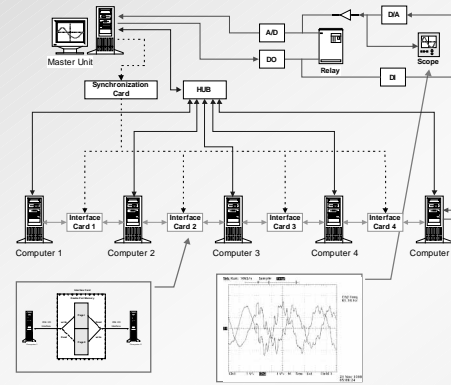
t = 30 s on Pentium II 400 MHz PC



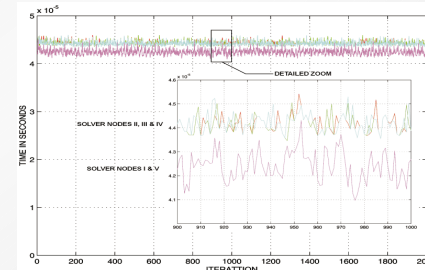
Large Networks Solution



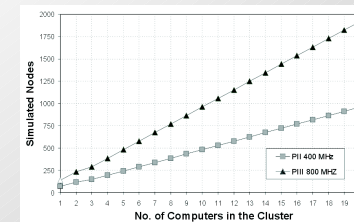
PC-Cluster Architecture



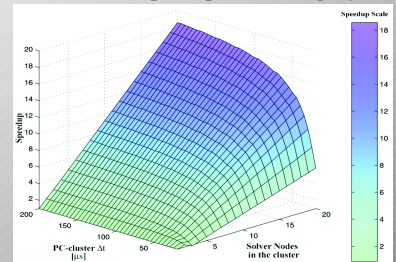
Execution Times per Iteration, Sample Case



Scalability for Real Time frame of 50 s

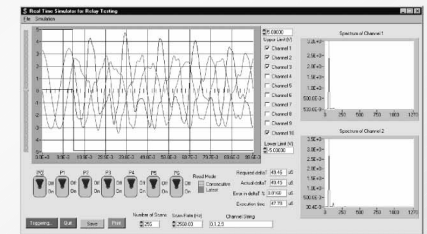


PC-Cluster Speedup, bus & ring layout

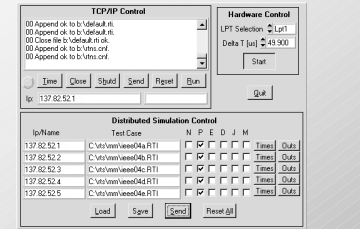


User Interface

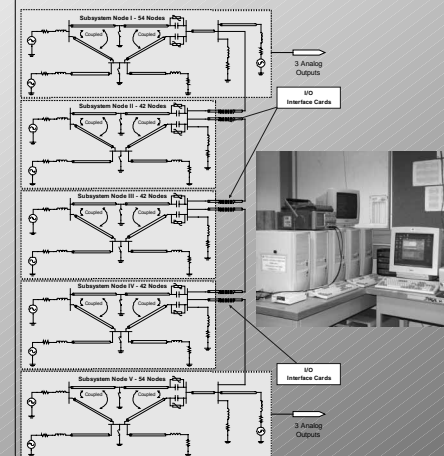
• OVNI Relay Tester User Interface.



• OVNI's PC-Cluster TCP/IP controller.



PC-Cluster Benchmark



OVNI Architecture	Solution Times	Simulated Nodes
Single PC	162 s/step	234
PC-Cluster	45.9 s/step	

PC-Cluster as follows	Solver Node	s/step	Nodes
	Solver Node I	45.34	54
	Solver Node II	45.90	42
	Solver Node III	45.81	42
	Solver Node IV	45.85	42
	Solver Node V	45.34	54

Pentium II, 400 MHz, Bus speed 66 MHz