A Grid-enabled Parallel Intelligent Ray Launching Algorithm for Outdoor and Indoor Wireless Propagation Coverage Prediction

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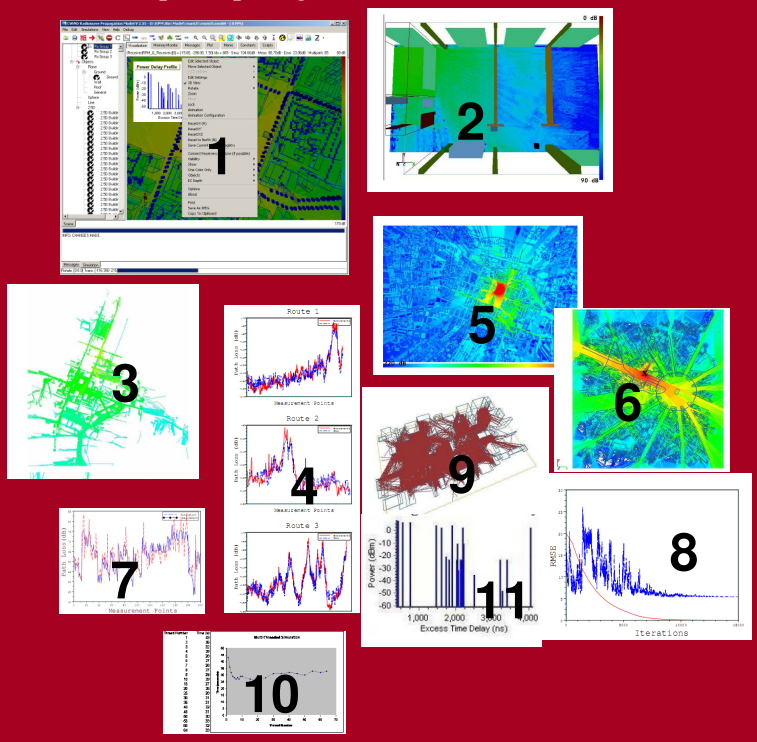
BACKGROUND

- radiowave propagation prediction is key to the quality of wireless networks to be designed
- the need for fast, accurate predictions from academic and industry is increasing rapidly
- empirical models are becoming obsolete
- huge demand for deterministic approaches but these are immature
- **core idea: develop a fast and accurate approach to predicting huge numbers of receiver points**
- grid computing aims to utilize world-scale unused desktop computing resources



1: Radio Tracer
2: Indoor Prediction
3: Parallel Screenshot
4: Outdoor Accuracy
5: Munich Coverage
6: Paris Coverage
7: Indoor Accuracy
8: SA-based Calibration
9: Outdoor Rays
10: Multi-threading
11: PDP

OBJECTIVES

- study and analyze existing approaches
- design a fast, accurate model (few minutes, 6-8 dB)
- target a huge number of receiver points (few million)
- employ parallel computing technologies
- apply the algorithms in distributed grid environment
- provide a fast, accurate solution for analysing other parameters apart from path loss
  - •Power Delay Profile (PDP)
  - •Angular Delay Spread (ADS)
  - •Directions of Arrival (DOA)
  - •Directions of Departure (DOP)

RESULTS

- Intelligent Ray Launching Algorithm (IRLA)
  - •Indoor (with material tuning)
  - •Outdoor
- CWiND Radiowave Tracer V2.5 (Written in Object Pascal, C++ and Assembly, More than 100K LOC)
  - •CWiND Radiowave Tracer Engine V2.30 (integrated in CWiND platform)
- multi-threading simulations improve speed on multi-core by around 80%
- auto-calibration is fast, each iteration is not an entire simulation; rather, it takes few calculation.
- accuracy and speed remain improvement.
- POP-C++ based simulation in grid (Written in g++)
- multi-processing + multi-threading
- the combination of **15 reflections and 15 diffractions** made possible **in half a minute!**
- **6-8 dB obtained (standard)**

FUTURE PLANS

- Design and Implementation of an Intelligent Job Scheduler for IRLA

CREDITS

- Michael Reyer (RWTH Aachen University)
- Hui Song, Alpar Juttner, Jun Wang, Alpar Jutter, Alvaro Valcarce and Guillaume delaRoche (University of Bedfordshire)
- Jean-Francois Roche and Laurent Winkler (University of Applied Sciences of Western Switzerland)

- Zhihua Lai, Nik Bessis, Guillaume de la Roche, Hui Song, Jie Zhang, and Gordon Clapworthy, An Intelligent Ray Launching for Urban Propagation Prediction, 3rd European Conference on Antennas and Propagation, EuCap, Berlin, Germany, 3 March, 2009.
- Zhihua Lai, Nik Bessis, Jie Zhang, and Gordon Clapworthy, Some Thoughts on Adaptive Grid-Enabled Optimisation Algorithms for Wireless Network Simulation and Planning, UK e-Science, All Hands Meeting, Nottingham, September 10-13, 2007, ISBN 978-0-9553988-3-4.

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