Visualizing the Internal Structure of SAT Instances

Carsten Sinz
WSI for Computer Science
In Search of Structure…

• Why are real-world instances so easy?
  – Bounded Model Checking: up to 100,000 vars.
  – Random 3-SAT: not more than 500 variables

• Typical answer: Structure

• But how does this structure manifest itself?
ssa2670-130
(DIMACS benchmark),
restricted
longmult8 (BMC), restricted
What about Dynamics?

- How does the variable interaction graph change during a run of DPLL algorithm?

Example from Product Configuration (C202-FW)
Observations on Easy Instances

• Long implication chains (2-clause-chains) in BMC instances

• Problems decay into independent components after a few steps of the DPLL algorithm

• Considerable simplification by unit propagation
Future Work

• Animated visualizations
• In-depth analysis of interaction graph properties
  – Implication chains, decomposition
  – Clustering, betweenness-centrality
  – Scale-freeness
• Specialized algorithms for structured instances