Surface Area Metric

\[ C = \begin{cases} 
C_t + C_iN \\
C_t + \frac{C_{L}S_{L} + C_{R}S_{R}}{S} 
\end{cases} \]

leaf nodes

interior nodes
Surface Area Metric

\[ C = \begin{cases} 
C_t + C_iN & \text{leaf nodes} \\
C_t + \frac{C_L S_L + C_R S_R}{S} & \text{interior nodes}
\end{cases} \]
Ordered Tree Rotations
Ordered Tree Rotations

Right Rotation
Ordered Tree Rotations

Left Rotation

Right Rotation
BVH Tree Rotations
BVH Tree Rotations

Diagram showing before and after rotations of a BVH tree structure.
BVH Tree Rotations
BVH Tree Rotations
BVH Tree Rotations
BVH Tree Rotations
BVH Tree Rotations

\[ C_t + \frac{C_{LS} + C_{RS}}{S} \]
Hill Climbing
Hill Climbing
Hill Climbing
Hill Climbing
Hill Climbing
Hill Climbing
Hill Climbing
Hill Climbing
Hill Climbing
Hill Climbing
Hill Climbing
Hill Climbing – Conference

Cost

Iteration
Simulated Annealing

- Energy function
- Candidate proposal mechanism
- Acceptance probability function
- Annealing schedule
Simulated Annealing

- Energy function → SAM
- Candidate proposal mechanism → Tree rotations
- Acceptance probability function → Boltzman factor: $P(\Delta e, T) = e^{-\Delta e/T}$
- Annealing schedule → Ramped, clamped sinusoid
Simulated Annealing – Soda Hall

The graph shows the cost and temperature variations over iterations. The cost decreases as the temperature decreases, indicating the optimization process of the algorithm.
Results – Hill Climbing

Opt: 1.71
SAM: 99.5%
Cast: 100.2%
Path: 100.7%

Opt: 1.23
SAM: 99.7%
Cast: 100.0%
Path: 100.8%

Opt: 0.18
SAM: 92.8%
Cast: 98.5%
Path: 94.6%

Opt: 0.53
SAM: 93.4%
Cast: 99.4%
Path: 99.3%

Opt: 0.24
SAM: 98.4%
Cast: 100.1%
Path: 101.6%

Opt: 0.13
SAM: 90.8%
Cast: 104.5%
Path: 99.3%

Opt: 0.68
SAM: 89.5%
Cast: 97.8%
Path: 88.6%

Opt: 4.93
SAM: 91.4%
Cast: 98.3%
Path: 98.6%
Results – Simulated Annealing

Opt:  528.26
SAM:  99.5%
Cast:  100.2%
Path:  100.7%

Opt:  426.48
SAM:  99.7%
Cast:  100.0%
Path:  100.8%

Opt:  44.44
SAM:  88.2%
Cast:  97.1%
Path:  85.4%

Opt:  114.08
SAM:  88.7%
Cast:  97.2%
Path:  91.6%

Opt:  74.11
SAM:  95.5%
Cast:  100.4%
Path:  99.6%

Opt:  28.51
SAM:  84.2%
Cast:  107.3%
Path:  96.7%

Opt:  119.26
SAM:  84.5%
Cast:  94.4%
Path:  82.4%

Opt:  857.7
SAM:  81.8%
Cast:  93.9%
Path:  97.7%
Conclusion

- Limitations
  - Leaves treated atomically
  - Modifies only existing nodes

- Results
  - New post-process optimization algorithms for BVHs
  - Verification of tree quality on densely tessellated meshes

- Future Work
  - SAM tuned for packets?
  - Combine with refitting for animation