



Contents

| | | |
|-----------------|--|-----------|
| 1 | Introduction | 1 |
| 2 | Known graph models from scientific computing | 3 |
| 2.1 | Determining nonzeros of sparse Jacobian matrices | 3 |
| 2.1.1 | Full Jacobian computation | 3 |
| 2.1.2 | Partial Jacobian computation | 8 |
| 2.2 | Combining partial Jacobian computation and ILU | 9 |
| 2.2.1 | Scientific computing problem | 10 |
| 2.2.2 | Combinatorial model | 11 |
| 3 | New coloring heuristics | 15 |
| 3.1 | Maximizing the set of additionally required elements | 17 |
| 3.1.1 | Restricted distance-2 coloring | 17 |
| 3.1.2 | Restricted star bicoloring | 29 |
| 3.2 | Application in geoscience | 35 |
| 3.3 | Coloring restricted to diagonal elements | 40 |
| 3.4 | Implementation details of PreCol | 43 |
| 4 | Interactive educational modules | 45 |
| 4.1 | Concept and design | 45 |
| 4.2 | Gamification | 47 |
| 4.3 | Available modules | 48 |
| 4.3.1 | Column compression | 48 |
| 4.3.2 | Full and partial Jacobian computation | 50 |
| 4.3.3 | Nested dissection ordering | 53 |
| 4.3.4 | Parallel matrix-vector product | 60 |
| 4.4 | New features in EXPLAIN 2.0 | 64 |
| 4.5 | Implementation details of EXPLAIN | 66 |
| 4.5.1 | Version 1.0 | 66 |
| 4.5.2 | Version 2.0 | 67 |
| 5 | Conclusion and future work | 73 |
| | Bibliography | 75 |
| | Appendix | 83 |
| A.1 | Comparing the computations of Algorithm 3.1 and Algorithm 3.2 | 83 |
| <i>Contents</i> | | |
| A.2 | Comparing the computations of Algorithm 3.2 and Algorithm 3.4 | 88 |
| A.3 | Comparing the computations of Algorithm 3.5 with different block sizes | 90 |