

Contents

1	Ferromagnetism and the Ising Model	2
1.1	Ferromagnetism	2
1.2	Ising Model	2
1.2.1	Joint Density of States	2
1.2.2	Thermodynamics	2
1.2.3	Relevance	2
2	Monte Carlo Methods Applied to the Ising Model	3
2.1	Metropolis	3
2.1.1	Critical Slowing Down	3
2.2	Wang-Landau	3
2.2.1	Algorithm	3
2.2.2	Variations	3
2.2.3	Success and Limitations	3
3	Flat Scan Sampling	4
3.1	Background	4
3.2	Algorithm	4
3.3	Implementations	4
3.3.1	Single Core	4
3.3.2	MPI	4
3.4	Validation and Convergence	4
3.5	Performance	4
3.5.1	Amdhal's Law and Parallel Scaling	4
3.6	Comparison with Wang-Landau Sampling	4
4	Thermodynamics and Finite Size Scaling	5
5	Conclusion and Future Work	6

Chapter 1

Ferromagnetism and the Ising Model

1.1 Ferromagnetism

1.2 Ising Model

1.2.1 Joint Density of States

1.2.2 Thermodynamics

1.2.3 Relevance

Chapter 2

Monte Carlo Methods Applied to the Ising Model

2.1 Metropolis

2.1.1 Critical Slowing Down

2.2 Wang-Landau

2.2.1 Algorithm

2.2.2 Variations

2.2.3 Success and Limitations

Chapter 3

Flat Scan Sampling

3.1 Background

3.2 Algorithm

3.3 Implementations

3.3.1 Single Core

3.3.2 MPI

3.4 Validation and Convergence

3.5 Performance

3.5.1 Amdahl's Law and Parallel Scaling

3.6 Comparison with Wang-Landau Sampling

Chapter 4

Thermodynamics and Finite Size Scaling

Chapter 5

Conclusion and Future Work