FYS4411 - Computational Physics II

Project 1

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Abstract

Write the abstract here

- Github repository containing programs and results are in: `https://github.com/evenmn/FYS4411/tree/master/Project%201`

1 Introduction

Introduction

2 Theory

Describe the physics here, including wavefunction and Hamiltonian

We study a system of N bosons trapped in a harmonic oscillator with the Hamiltonian given by

$$\hat{H} = \sum_i^N \left(-\frac{\hbar^2}{2m}\nabla_i^2 + V_{ext}(\vec{r}_i)\right) + \sum_{i<j}^N V_{int}(\vec{r}_i, \vec{r}_j) \tag{1}$$

with V_{ext} as the external potential, given by the harmonic oscillator potential, and V_{int} as the interaction term, which can be ignored when developing the benchmarks.

The wavefunction is on the form

$$\Psi_T(\vec{r}_1, \vec{r}_2, ..., \vec{r}_N, \alpha, \beta) = \prod_i^N g(\alpha, \beta, \vec{r}_i) \prod_{i<j} f(a, r_{ij}) \tag{2}$$

where g is assumed to be an exponential

$$g(\alpha, \beta, \vec{r}_i) = \exp[-\alpha(x_i^2 + y_i^2 + \beta z_i^2)] \tag{3}$$

which is practicle since

$$\prod_i^N g(\alpha, \beta, \vec{r}_i) = \exp[-\alpha(x_1^2 + y_1^2 + \beta z_1^2 + \cdots x_N^2 + y_N^2 + \beta z_N^2)] \tag{4}$$

Present most important results form exercise a

3 Methods

3.1 Variational Monte Carlo

3.2 Metropolis algorithm

3.2.1 Brute force

3.2.2 Importance sampling

4 Results

5 Discussion

6 Conclusion