Contents

1 Abstract

All files for this project are available at GitHub[1].

2 Introduction

3 Obligbesvarelse

a)

If U is orthogonal, $U^T U = I$. This implies:

$$\vec{w}_i^T \vec{w}_j = (U\vec{v}_i)^T (U\vec{v}_j) = \vec{v}_i^T \overbrace{U^T U}^{I} \vec{v}_j = \vec{v}_i^T \vec{v}_j = \vec{v}_i \cdot \vec{v}_j$$

Orthogonal transformations hence conserve the inner product, and therefore also the orthogonality.

[1] https://github.com/anjohan/Offentlig/tree/master/FYS3150/Oblig2

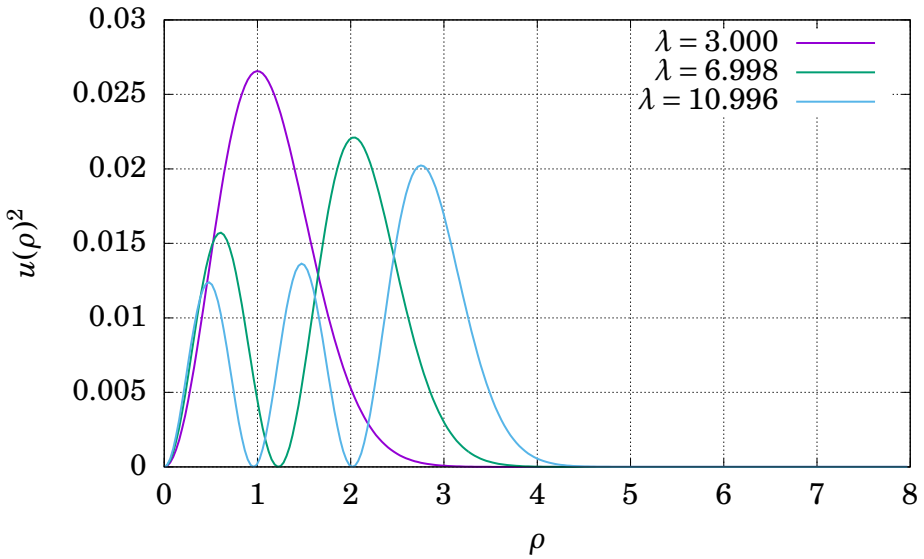

Figure 1: Simulation of one particle in a harmonic oscillator potential for $n = 250$ with $\rho_{\max} = 8$.

n	λ_0	λ_1	λ_2	Number of iterations
50	2.992	6.960	10.902	2863
100	2.998	6.990	10.976	12307
150	2.999	6.996	10.989	28353
200	2.999	6.997	10.994	51095
250	3.000	6.998	10.996	80474

Table 1: The three lowest eigenvalues found by the algorithm for the different number of mesh points n. The analytical values are $\lambda_0 = 3$, $\lambda_1 = 7$ and $\lambda_2 = 11$.

The number of iterations is approximately quadrupled when the number of mesh points is doubled, indicating that the numbers of iterations runs as n^2. This means that the number of iterations is proportional to the number of elements in the matrix. Note that the matrices handled in this project are tridiagonal, and the trends may be different for dense matrices.

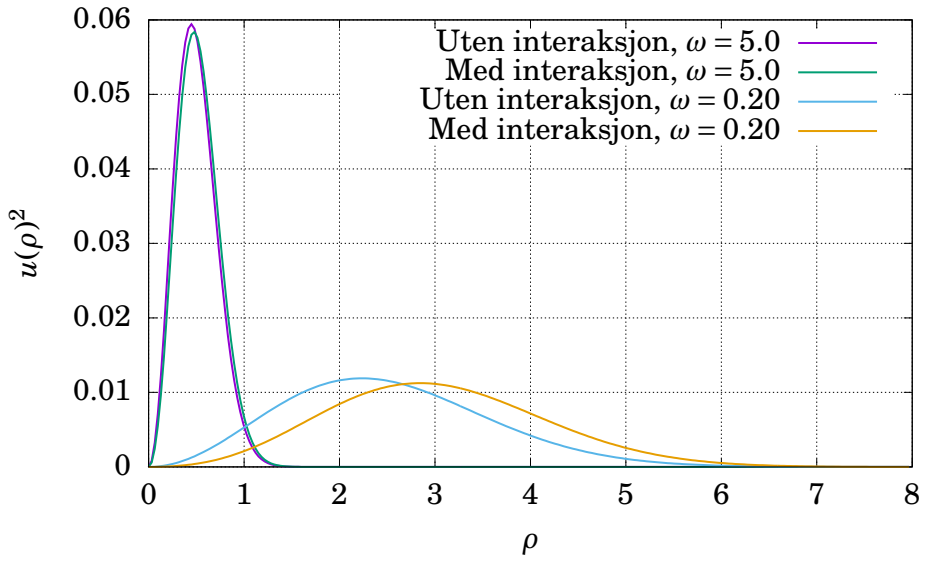

Figure 2: Simulation of two particles, with and without Coulomb interaction, for two different values of ω. A larger ω corresponds to a stronger harmonic oscillator.