



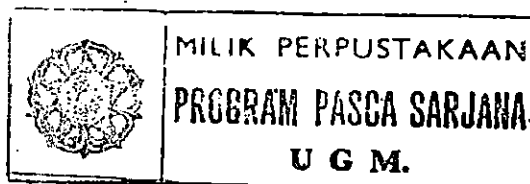
Simulasi mekanika kuantum satu dimensi menggunakan metode Pseudo-Spektral
DWIPUTRANTO, Surjawirawan, Dr. H. Sumartono Prawirosusanto

SIMULASI MEKANIKA KUANTUM SATU DIMENSI MENGUNAKAN METODE PSEUDO-SPEKTRAL

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INTISARI

Telah dilakukan simulasi mekanika kuantum dengan metode pseudo-spektral yang berbasiskan pada Transformasi Fourier Cepat dan metode pendekatan operator terpisah orde dua. Sistem fisika kuantum yang diteliti adalah partikel pada potensial bebas, potensial linear, potensial kuadrat, potensial undak dan potensial tanggul (efek terobosan). Diperoleh bahwa untuk fungsi gelombang partikel berbentuk gauss-an ralat metode spektral ini terhadap hasil eksak pada potensial bebas dan potensial linear tidak lebih dari $9,0 \cdot 10^{-7}\%$. Sedangkan pengukuran kecepatan rambat fungsi gelombang diperoleh dengan ralat 1% oleh karena ralat dalam pengukuran posisi fungsi gelombang. Pada sistem potensial kuadratis dapat divisualisasikan perilaku rata-rata fungsi gelombang yang ternyata mengikuti gerak mekanika klasik. Pada potensial undak dan potensial tanggul dapat divisualisasikan peristiwa refleksi dan transmisi, yang memperlihatkan adanya pola-pola puncak maksimum-minimum pada daerah refleksi dan adanya efek penetrasi sebelum refleksi. Diperoleh pula bahwa penghalusan tepi potensial undak dan tanggul mengakibatkan berkurangnya pola-pola puncak maksimum dan minimum tersebut, meningkatnya efek penetrasi dan membesarnya koefisien transmisi.





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ONE DIMENSION QUANTUM MECHANICS SIMULATION

BY PSEUDO-SPECTRAL METHODS

by

Surjawirawan Dwiputranto

ABSTRACT

The quantum mechanics simulation by pseudo-spectral methods based on Fast Fourier Transform and second order split operator approach was conducted. The quantum systems being studied were particle in free, linear and quadratic potential, particle against potential step and potential barrier (tunneling effect). It was found that the error from the exact solution of a gaussian particle wave function in free potential or in linear potential was not more than $9,0 \cdot 10^{-7}$ %. The propagation velocity of the wave function was obtained in 1% uncertainty due to an error in the measurement of the position of the wave function. It was found in the visualization that the average behavior of the wave function in quadratic potential follows its classical mechanics behavior. The reflection and transmission of wave function at potential steps and potential barrier could be investigated in the visualization. It was seen, near the potential barrier, some maximum-minimum peak patterns appeared in the wave function due to superposition of the incident and the reflected wave. It could be concluded that some penetration occurred before reflection by investigating the graph of transmission coefficient as function of time. The smoothing of the edge of the rectangular potential steps and the potential barrier reduced the appearance of the maximum-minimum patterns but increased the transmission coefficient and the penetration.

