ASEC 2024 Conference
The 5th International Electronic Conference on Applied Sciences
04–06 December 2024 | Online

Comparaison the performance of DC motor's and PMSM's control based on the SFS Algorithm

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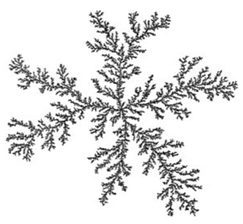
Abstract

In modern electric drive systems, DC motors and PMSMs offer distinct advantages. DC motors excel in simplicity and precise speed control, while PMSMs provide higher efficiency and superior performance for demanding applications. This poster presents the application of the Stochastic Fractal Search (SFS) Algorithm to optimize PI controller parameters for speed control in both motors, comparing their performance. The SFS algorithm minimizes the Integral of Time-weighted Absolute Error (ITAE) to enhance control stability, overshoot, rise time, steady-state error, and settling time. Results show significant improvements, with the PMSM control system outperforming the DC motor, highlighting the effectiveness of the SFS algorithm for advanced PMSM applications.

Stochastic fractal search(SFS)



SFS Algorithm

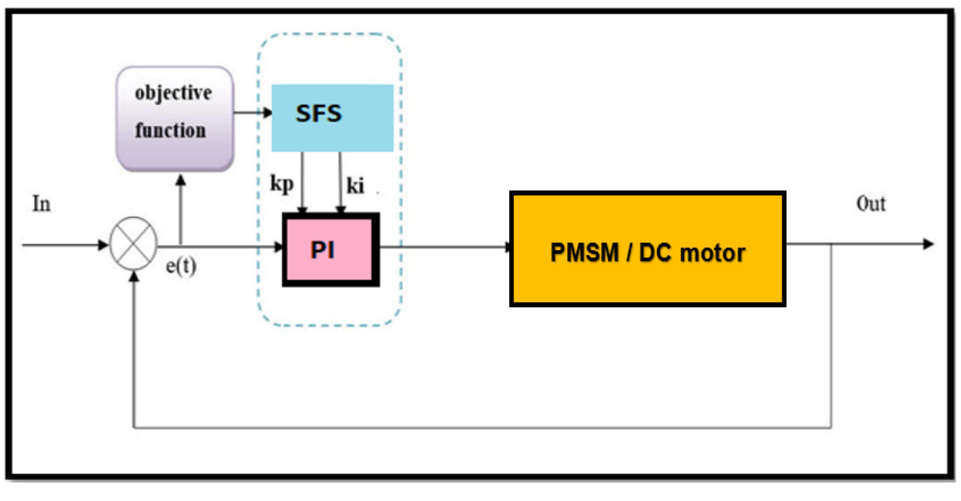
Population initialization
Set total number of populations
Set maximum number of iterations

Diffusion process
Set maximum number of diffusion parameters

Gaussian walk
Apply first Gaussian walk
Find the first new position of particles
Apply second Gaussian walk
Find the second new position of particles

Updating process
Ranked all search agent
Use two updating process
Find best search agent

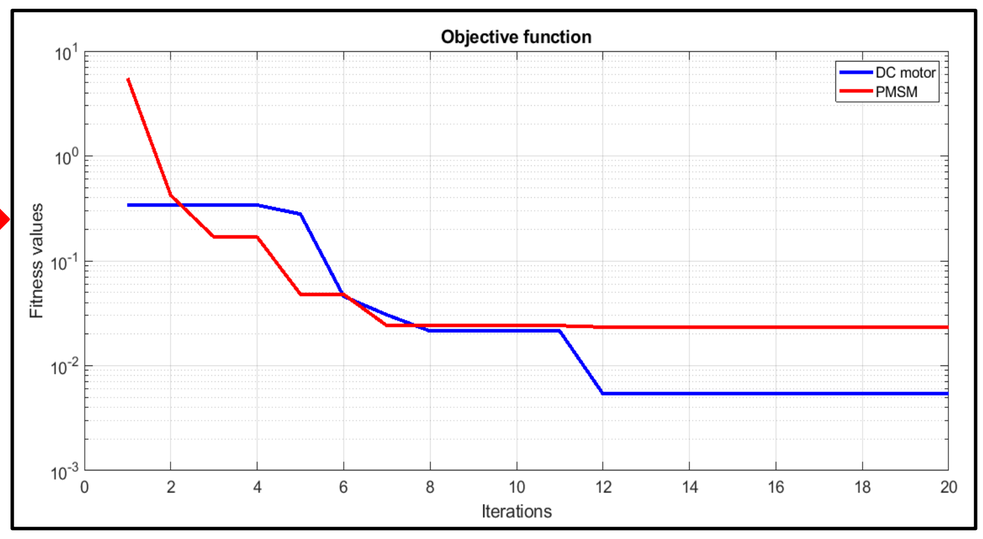
Control of PMSM Motor with SFS Method

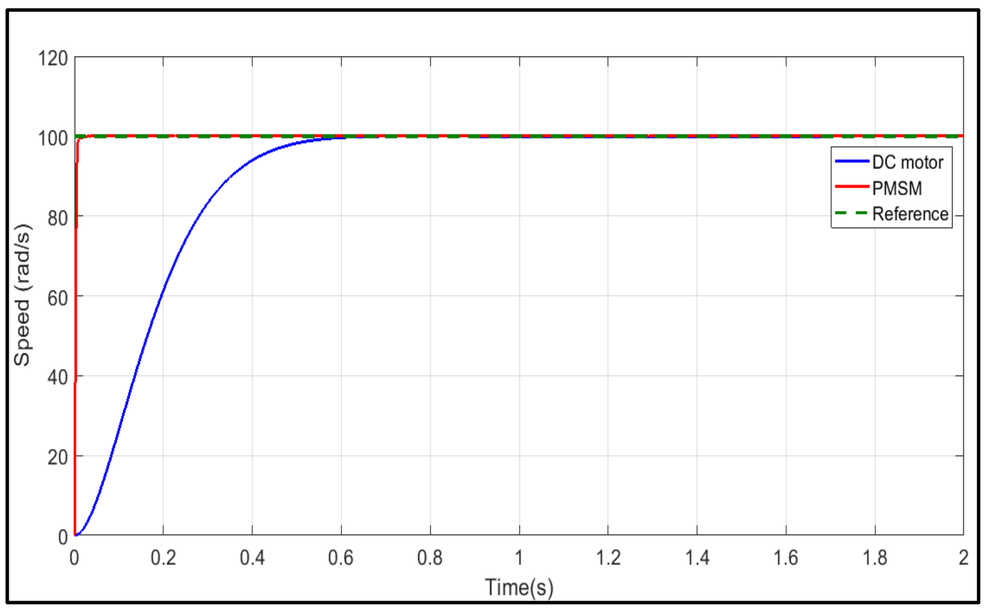


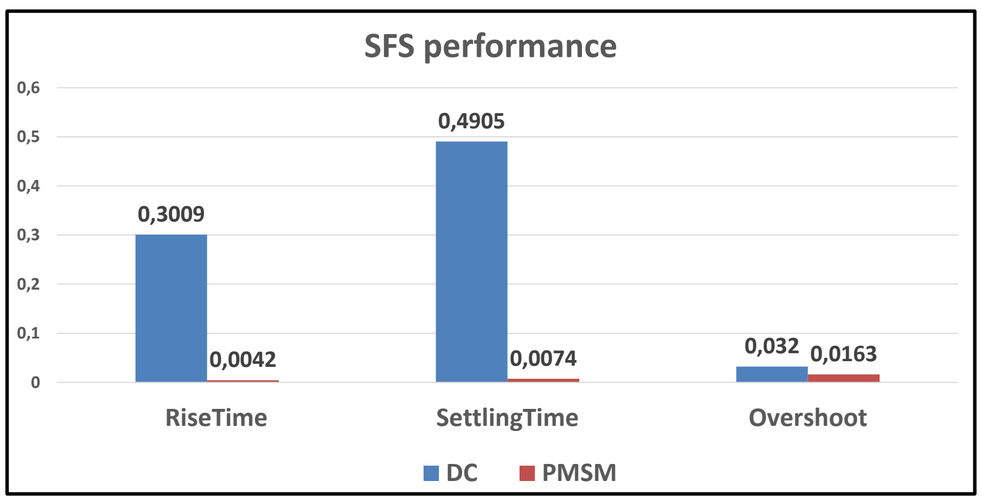
The objective function is: $ITAE = \int_0^\infty t|e(t)|dt$

Simulation results

Objective function







Conclusion

The application of the Stochastic Fractal Search (SFS) Algorithm demonstrates its potential in optimizing PI controller parameters for both DC motors and PMSMs. While DC motors achieved better fitness values due to their simpler dynamics, PMSMs exhibited superior performance in key metrics such as rise time, overshoot, and overall control stability. These findings highlight the SFS algorithm's capability to enhance motor performance, particularly for complex systems like PMSMs, making it a promising tool for advanced electric drive applications where efficiency and precision are critical.

Reference

[1] Salimi, H. (2015). Stochastic Fractal Search: A Powerful Metaheuristic Algorithm. *Knowledge-Based Systems*, 76, 1–18.