Nonlinear Dynamics and Systems Theory, **24** (4) (2024) 392–399

Square Root Ensemble Kalman Filter for Forefinger Motion Estimation as Post-Stroke Patients' Medical Rehabilitation

T. Herlambang [1], F. A. Susanto [1], H. Nurhadi [2], K. Oktafianto [3], H. Arof [4] and R. S. Marjianto [5*]

[1] *Department of Information Systems, Universitas Nahdlatul Ulama Surabaya, Indonesia.*
[2] *Department of Industrial Mechanical Engineering, Sepuluh Nopember Institute of Technology, Indonesia.*
[3] *Department of Mathematics, University of PGRI Ronggolawe, Indonesia.*
[4] *Department of Electrical Engineering, University of Malaya, Malaysia.*
[5*] *Department of Engineering, Faculty of Vocational Studies, University of Airlangga, Surabaya, Indonesia.*

Received: August 18, 2023; Revised: June 17, 2024

Abstract: Hemiparesis is a medical term to describe a condition of weakness on one side of the body or the inability to move a limb on one side. The term comes from the word 'hemi' meaning half or one side and "paresis" meaning weakness. Hemiparesis patients are still able to move the affected side of the body and are not completely paralyzed. It is just that the side of the body experiencing the disorder is so weak and powerless, the movements that arise are also very little. Current robotics technology has developed rapidly along with advances in science and technology to assist medical rehabilitation, one of which is a post-stroke rehabilitation, especially the rehabilitation of finger movement. One technology useful to develop is the finger motion estimation of the Finger Prosthetic Robotic Arm for patients with upper extremity paresis. Finger motion estimation is one of the important aspects in the development of such technology because it is designed to determine the accuracy and effectiveness of the robot in providing motion assistance to hands affected by paresis. The study in this paper used the Square Root Kalman Filter method to estimate the motion of the index finger robot by generating 250 ensembles, 500 ensembles and 750 ensembles. The simulation results with 750 ensembles have the best accuracy of around 97-98%.

Keywords: *hemiparesis, finger prosthetic robotic arm; EnKF; SR-EnKF; forefinger motion estimation.*

Mathematics Subject Classification (2010): 93E10, 62F10.

* Corresponding author: mailto:rachmansinatriya@vokasi.unair.ac.id