



Motion Estimation of Third Finger Using Ensemble and Unscented Kalman Filter for Inverse Kinematic of Assistive Finger-Arm Robot

T. Herlambang^{1*}, H. Nurhadi², A. Suryowinoto³, D. Rahmalia⁴
and K. Oktafianto⁵

¹ Department of Information Systems, Universitas Nahdlatul Ulama Surabaya, Indonesia.

² Department of Industrial Mechanical Engineering, Sepuluh Nopember Institute of Technology, Indonesia.

³ Electrical Engineering Department, Adhi Tama Institute of Technology Surabaya, Indonesia.

⁴ Department of Mathematics, University of Islam Darul Ulum Lamongan, Indonesia.

⁵ Department of Mathematics, University of PGRI Ronggolawe, Indonesia.

Received: October 20, 2022; Revised: October 16, 2023

Abstract: The Islamic Hospital (RSI) Jemursari and RSI A. Yani always attempts to achieve an optimal community health status by health maintenance, health improvement (promotive), disease prevention (preventive), healing (curative) and recovery (rehabilitative) approaches in a comprehensive, integrated, and sustainable way. Specialists in prosthetics and orthotics, as the health professionals who are members of the medical rehabilitation team unit in Indonesia, are responsible for carrying out medical rehabilitation activities. The goal of the medical rehabilitation is to achieve its maximum functional competence and to prevent recurrent attacks. For this, a biomedical technology, that is, an assistive finger-arm robot, is required to help the recovery. The assistive finger-arm robot is one solution to assist the recovery process of paresis patients, specifically for finger movement. One of the research and development efforts on the assistive finger-arm robot is finger motion estimation. Several reliable motion estimation methods frequently used are the Unscented Kalman Filter (UKF) and Ensemble Kalman Filter (EnKF) methods, which are very reliable for either forward and inverse kinematic models or nonlinear models. Therefore, both methods were used in this study. Before the estimation was carried out, we started with modeling the inverse kinematics of the finger-arm robot as a platform for emulating the real movement of the fingers, to be specific, the third finger only. In this case, the third finger size was taken from the Surabaya citizens from Indonesia. The simulation results show that both methods had a fairly small error of about 2.5%–4.23%.

Keywords: *finger-arm robot; UKF; EnKF; inverse kinematic models.*

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

* Corresponding author: <mailto:teguh@unusa.ac.id>