

FEATURE SELECTION IN PUSH CLASSIFICATION USING DEEP LEARNING FOR HUMANOID ROBOT PUSH RECOVERY

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ABSTRACT

In the complex robot systems, humanoid robots are one of the futuristic technologies. Humanoid robots have high number of degrees of freedom. They also exhibit unstable nature of dynamics. Hence predicting and analyzing full body behavior of humanoid robots is difficult. Classification of push is an important requirement for decision-making in humanoid robots. Two essential skills that allow humanoid robots to do difficult tasks related to locomotion are pushing-recovery and balancing. In this paper we have attempted to build a humanoid robot for push recovery with the help of machine-learning techniques. This is carried out by exerting three types of pushes viz, small, medium, and large and the push recovery of the subjects are examined. Based on which the joint angles are collected. The collected angles are converted into intrinsic mode function values using the Extrinsic Mode decomposition. Six different features are derived and added two more features, namely Skewness and Kurtosis. Were also used to classify the types of pushes. A comparative study has been carried out for eight features as well as with the six features. We obtained an accuracy of 84.3% for the eight features and 71.3% for the other six features. Stepwise discriminant analysis has been applied for the eight features to identify significant features that resulted in Skewness and Kurtosis. Higher accuracy of 95% has been achieved through deep learning using these features.

Keywords: Push recovery, Intrinsic mode function, Extrinsic mode decomposition, Empirical Mode Decomposition, Deep Neural Network, feature selection, Stepwise feature selection.

INTRODUCTION

The human-like robot is mainly created to replicate the shape of the human body to interact with the biophysical environmental condition and for various new exploration processes. This application got successful in the field of science, but the challenge of duplicating the human was still present. In recent years, with the advancement of science, humanoid robots have given few outstanding achievements that mankind is yet to accomplish. The extent to which a Human recover from a push increase with age, and it slows down with age. A normal healthy person has better push recovery when compared to a child, and an elderly person as their center of gravity is shifted. They have poor push recovery when compared to the younger ones. With the advancement in science, the push recovery in the robot is still difficult because the robot relies on the input data to function, and they don't have good decision-making capability as humans have. The environment of the world is meant for humankind. Most of the robots are tried by replicating the exact work performed by humans but under a new environment with lots of changes, and they are not cost-effective. So, one should aim to build up a robot that can be used in real-time under the existing available infrastructure without much deviation. In the earlier gait analysis studies, push recovery of humanoid robots can be done with the help of integration of the machine