National Institute of Technology Rourkela

Defence Seminar

Seminar Title	: Human Robot Interaction with Motion-based Imitation Mechanism
Speaker	: Archana Balmik (Rollno : 518cs1001)
Supervisor	: Prof. Anup Nandy
Venue	: HOD Room (Ground Floor), CS Department
Date and Time	: 17 Jul 2024 (10:00 AM)
Abstract	: The ability of robots to perceive and replicate human motions is a fundamental aspect of human-robot interaction. The present research aims to explore the capability of NAO humanoid robot to imitate whole-body human behaviour for effective human-robot interaction. The Microsoft Kinect v2.0 is used to capture human behaviour in the form of joint positions. The cubic spline interpolation is applied to the skeleton joint positions to ensure minimal noise interference. A novel estimation method based on analytical geometry and vector algebra is proposed to compute the joint angles for the NAO robot. A low-pass Savitzky-Golay filter is applied to the joint angles to create smoother motion trajectories. A novel data augmentation technique is applied, which effectively generates additional samples resembling the original motion instances. Subsequently, the joint angles are transferred to the NAO robot. The robot&rsquos ability to imitate whole-body behaviour depends heavily on its balance control algorithm. It is responsible for providing stability and balance to the robot. A novel technique named Adaptive Balancing Technique for NAO (ABTN) is proposed to address this challenge. This technique focuses on achieving dynamic balancing of the robot in both single and double supporting phases. The proposed approach uses the center of mass to calculate joint angles using a novel pitch and roll control algorithm. It is crucial to carefully select the most relevant features from a vast amount of motion data. To deal with this problem, a novel feature selection method based on eigen values and Signal-to-noise ratio (SNR) has been proposed. This technique identifies robot joint angles as the most optimized feature for motion recognition and imitation frameworks. These features are subsequently fed as input into a proposed 1D-CNN model, achieving an accuracy of 97%. The predicted motions are then transferred to the NAO robot to imitate human motions precisely. The findings reveal that the NAO robot can successfully imitate a variety of human motions.