Kinematic Calibration of Phantom X Robot Pincher Arm

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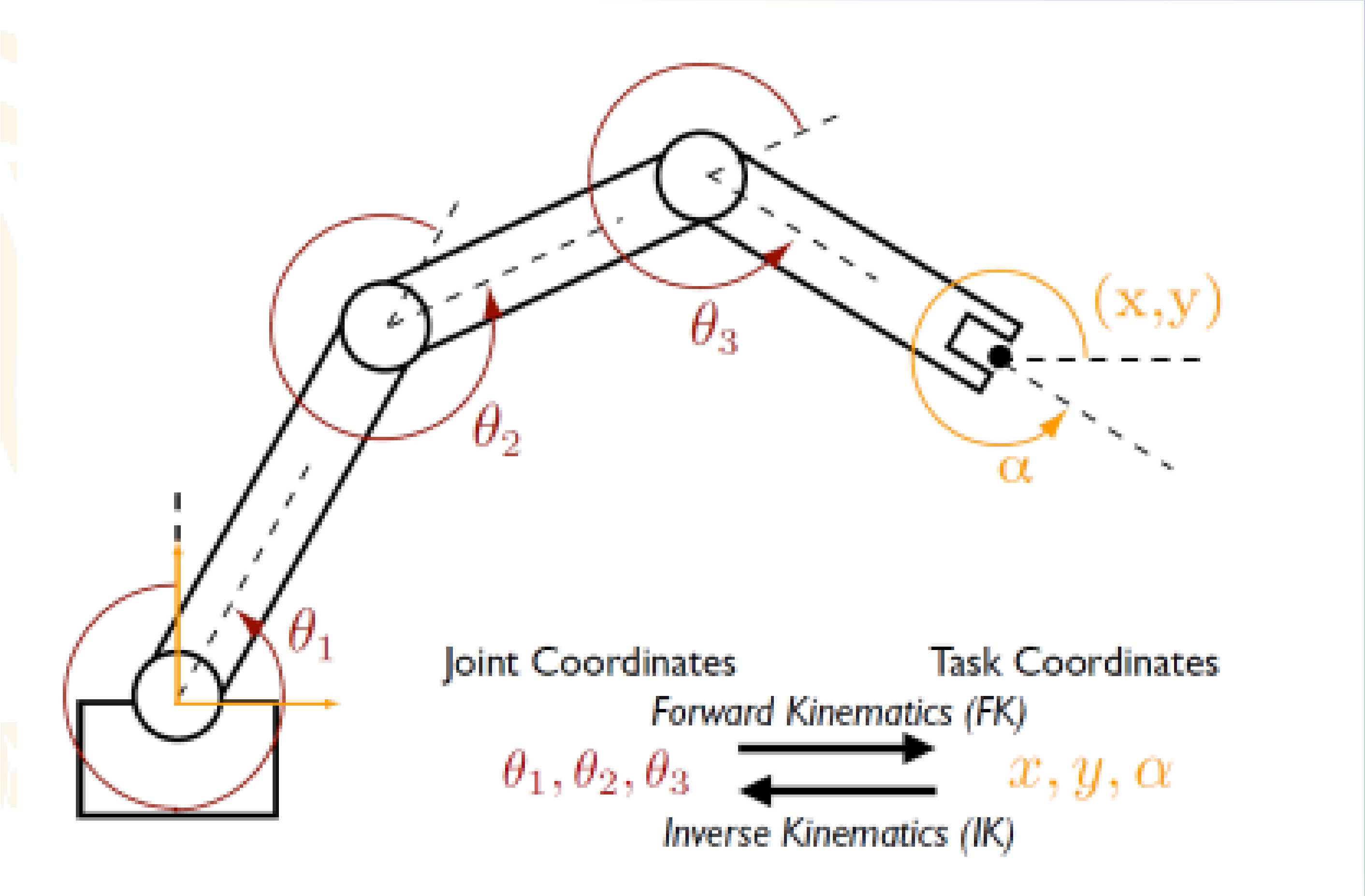
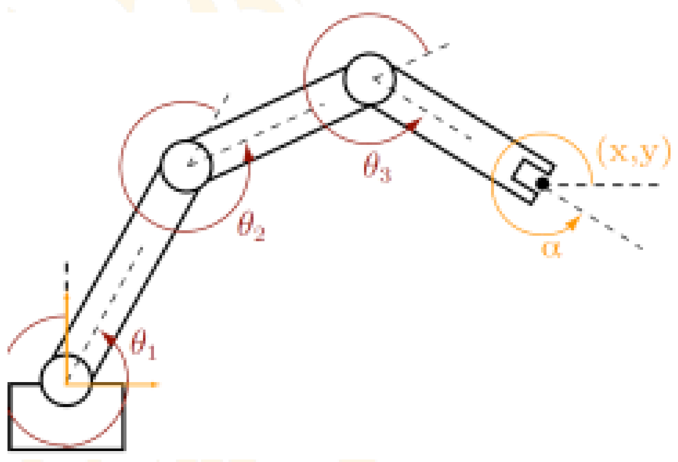
Agenda

- Research Questions and Introduction to the Topic
- Methodology
- Relevant Literature
- Preliminary Findings and Progress
- Relevance of Kinematically calibrating Industrial Robots

Brief overview of Kinematic Calibration and our Research Questions

- The process of accurately measuring and adjusting the geometric parameters of a robotic system to improve its positional accuracy and repeatability
- Involves determining the precise relationship between the robot's commanded motions and its actual movements in the workspace.

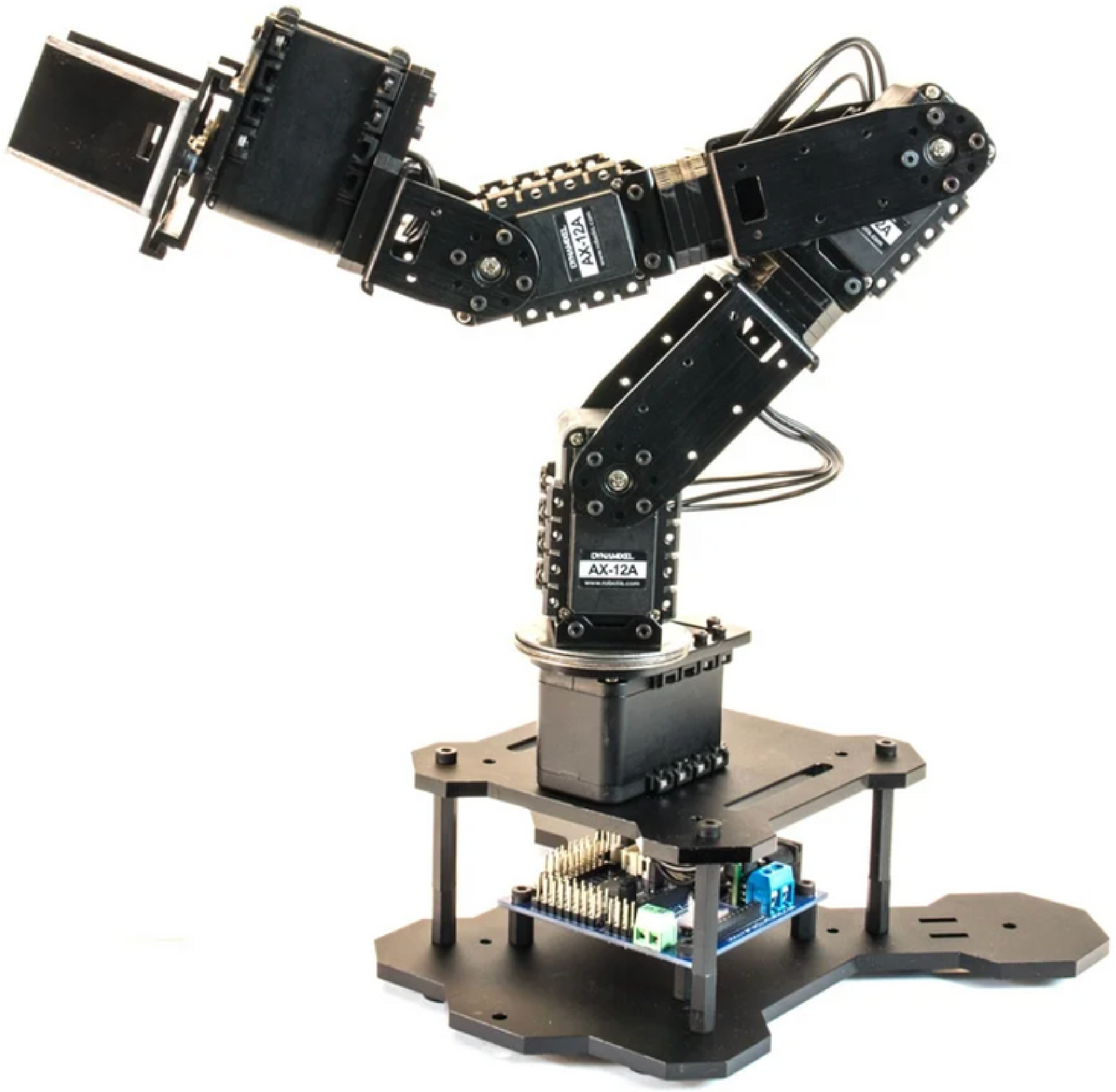




- $x =$ $L_1 \cos\theta_1 + L_2 \cos(\theta_1 + \theta_2) + L_3 \cos(\theta_1 + \theta_2 + \theta_3)$
- $y =$ $L_1 \sin\theta_1 + L_2 \sin(\theta_1 + \theta_2) + L_3 \sin(\theta_1 + \theta_2 + \theta_3)$
- $\alpha = \theta_1 + \theta_2 + \theta_3$

Research Questions

- How will the accuracy improvement achieved through calibration be assessed?
- Is there a better mathemtical model for the Kinematics of the Robot?
- Different approaches for Kinematic calibration have been adopted over time.
- Which approach yields the best results in terms of accuracy achieved?
- How many measurements need to be taken to achieve a specified calibration accuracy?



Methodology

- Extensive Literature Review of the already established calibration techniques and their accuracy
- Fast-paced course on Robot Kinematics to equip researchers with the necessary skills
- Familirization with the functioning of the Phantom X Robot Arm
- Selecting 2-3 approaches from our literature review to determine their accuracy
- Developing an experiment design which encapsulates all prerequisites to embark on development work

Preliminary Findings and Progress

- Pose estimation of the Robot Arm using IMU Sensors and Computer Vision is our main objective for the current phase of the research
- IMU Method has been paused for the moment due to complexity of mounting the sensors on the end-effector
- Pose estimation using ARUCO markers and Python's OpenCV library has been employed
- ARUCO markers are successfully being detected
- However numerous errors have been encountered in the efforts to estimate the pose, primarily due to difficulties in the extrinsic and intrinsic calibration of the Intel RealSense Camera
- Developing a structure with help of 3D printing to mount the ARUCO markers on the end-effector is one of the aims of our research in the coming week

Overview of Literature Review

Kinematic Model Description
- DH parameters
- Modified DH parameters
- POE model

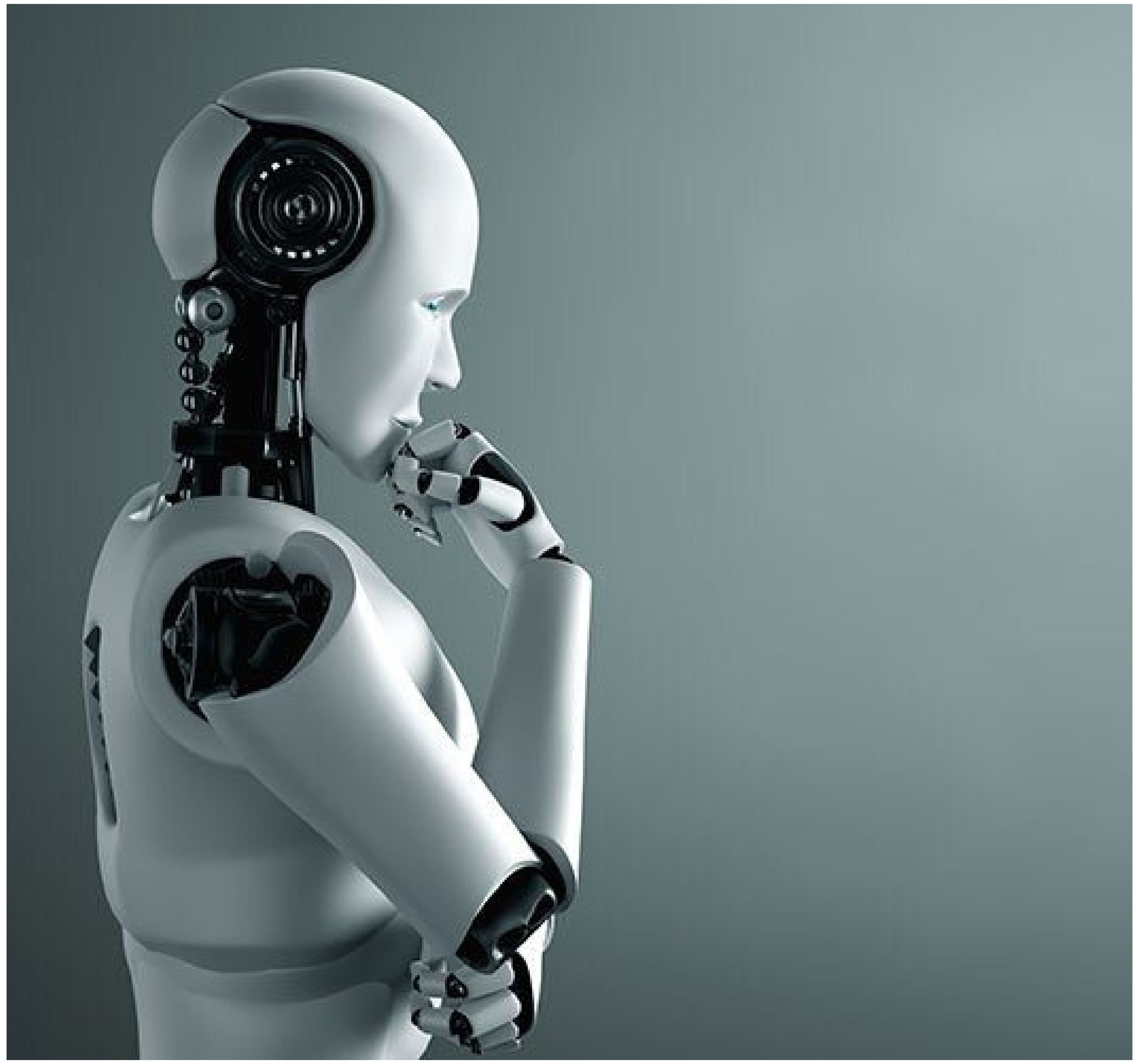
Pose Measurement Method
- Pose is the description of the robot's orientation and position
- Laser module and camera
- IMU and position sensors

Kinematic Parameters Identification Model
- Most common method of error in kinematic parameters is lest squares method
- The error in desired and obtained position
- Position the robot where we want to

Results/Accuracy
- Different experiments carried out on the robots
- Calculating error before and after calibration

Relevance of Kinematic Calibration of Industrial Robots

- Kinematic calibration improves robot accuracy and precision.
- Calibration compensates for variations and ensures consistent performance.
- Crucial for high-accuracy applications like aerospace and medical robotics.
- Determining the most accurate calibration method is vital.
- It minimizes errors and uncertainties in the calibration process.
- The right method enhances robot performance and reliability.
- Optimized calibration reduces downtime and costs.
- Enables advanced control techniques and motion planning.
- Compliance with industry standards and regulations.
- Enhances system performance and productivity.



Thank you for giving us the opportunity to present our research and providing your undivided attention!