Vibration Measuring of the Mitsubishi RV – 3SB , Robot manipulator using LabView Virtual Measuring Device

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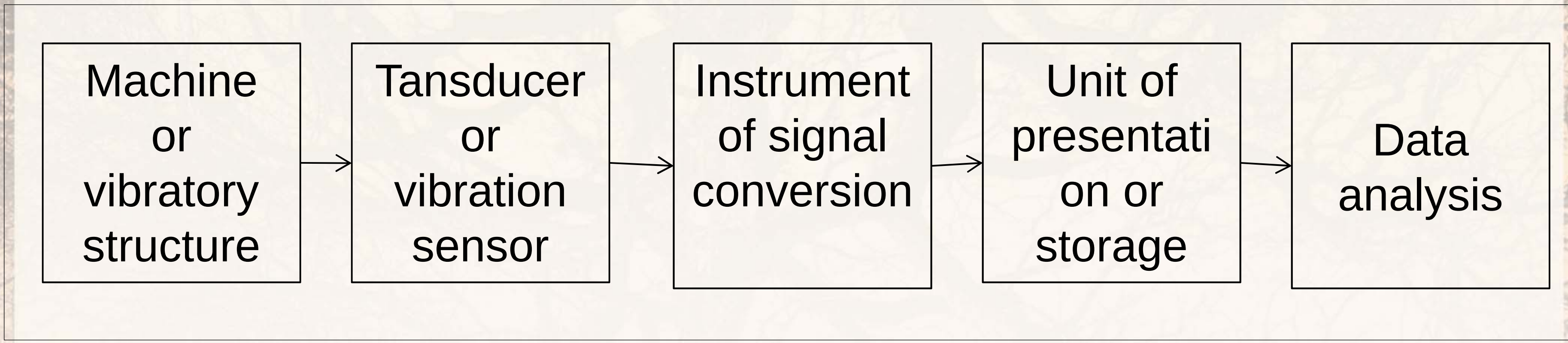
Vibration Measurement

The analysis of vibrations requires that this to be perfectly identified. This happens by a metering process. It is extremely important the correct vibration measurement for that the process of analysis and correction subsequent are not compromised.

Vibration Measurement

Steps for vibrations measuring



Labview

Analogue and Digital Instruments

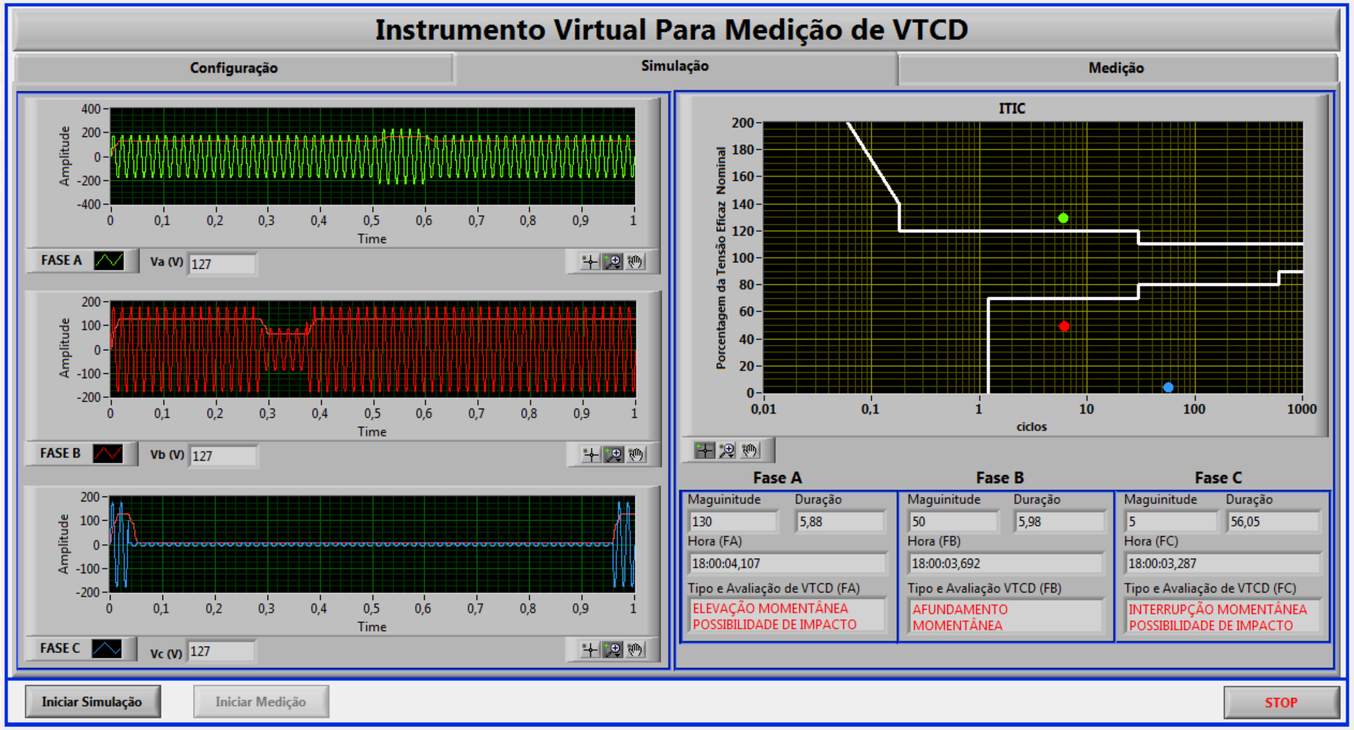
- The analogue and digital instruments, despite the enormous applicability, have the disadvantage of having only the features defined by the manufacturer

Virtual Instruments

- virtual instrument is a flexible instrument that has buttons, displays, indicators, and others, emulated by the computer, which in turn connects with the real world through a data acquisition hardware (signal conditioners, sensors, transducers, among others)

Labview

Front Panel of a Virtual Instrument – “User interface”



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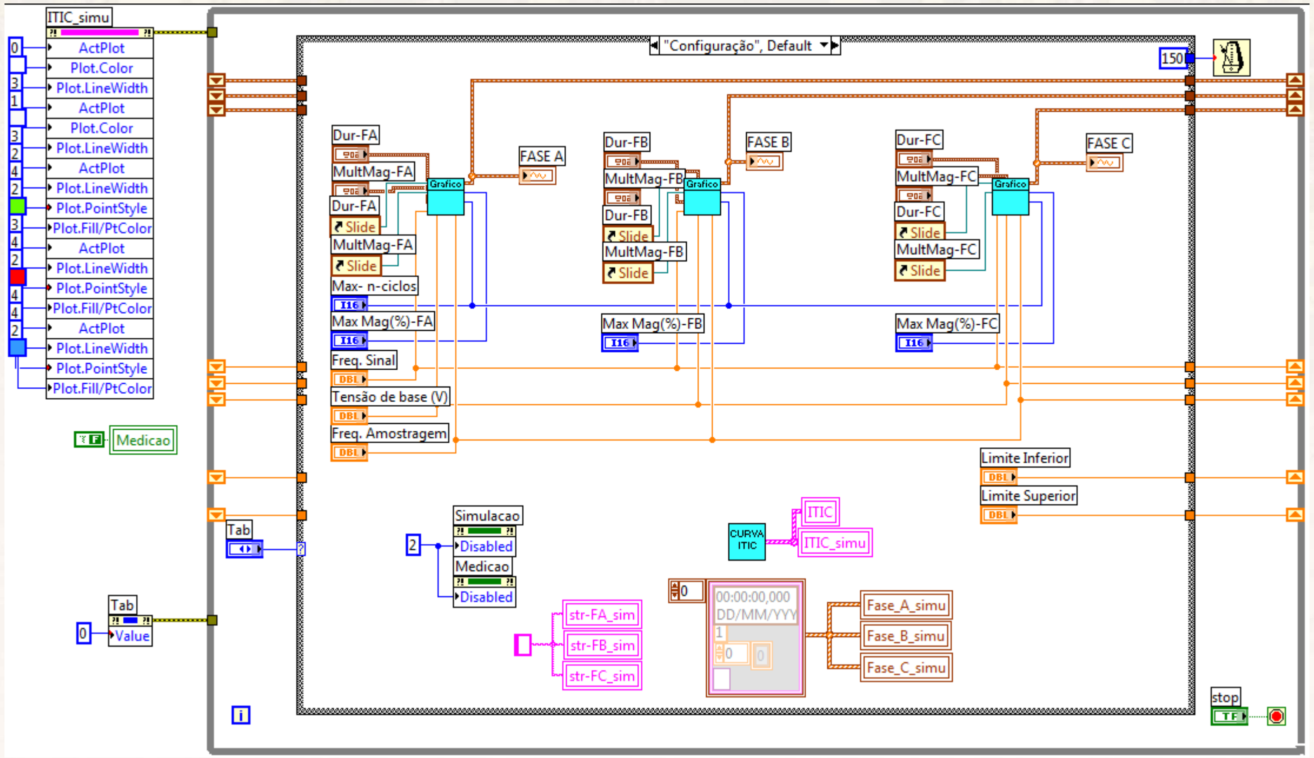
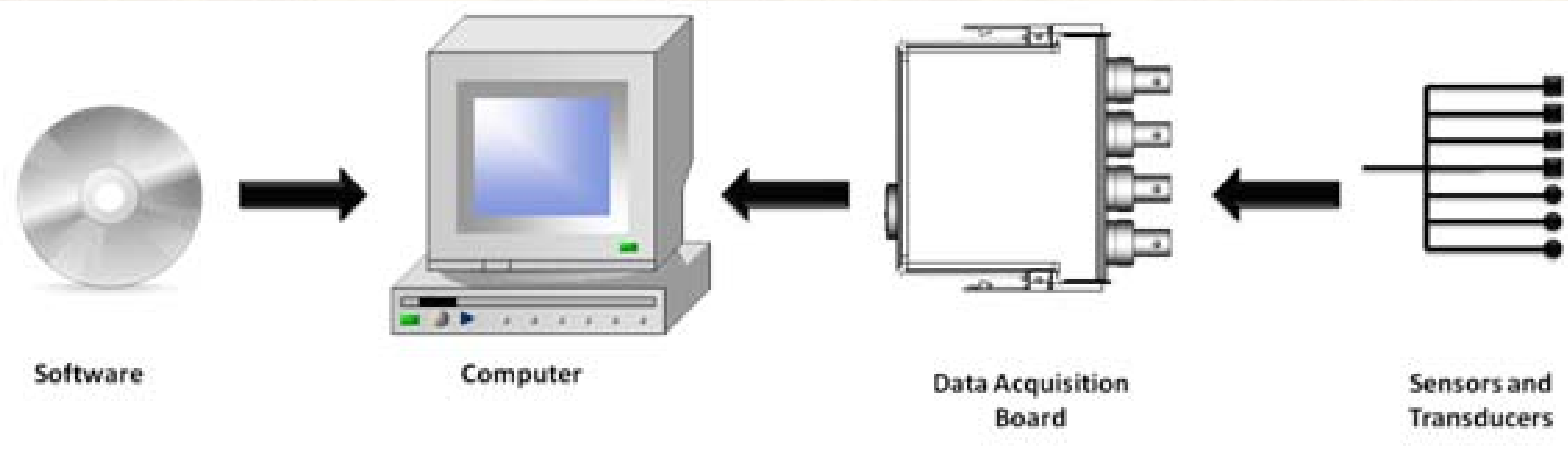
Labview

Block Diagram of a Virtual Instrument – “Workplace Programmer”



Labview

Basic scheme of a Virtual Instrumentation

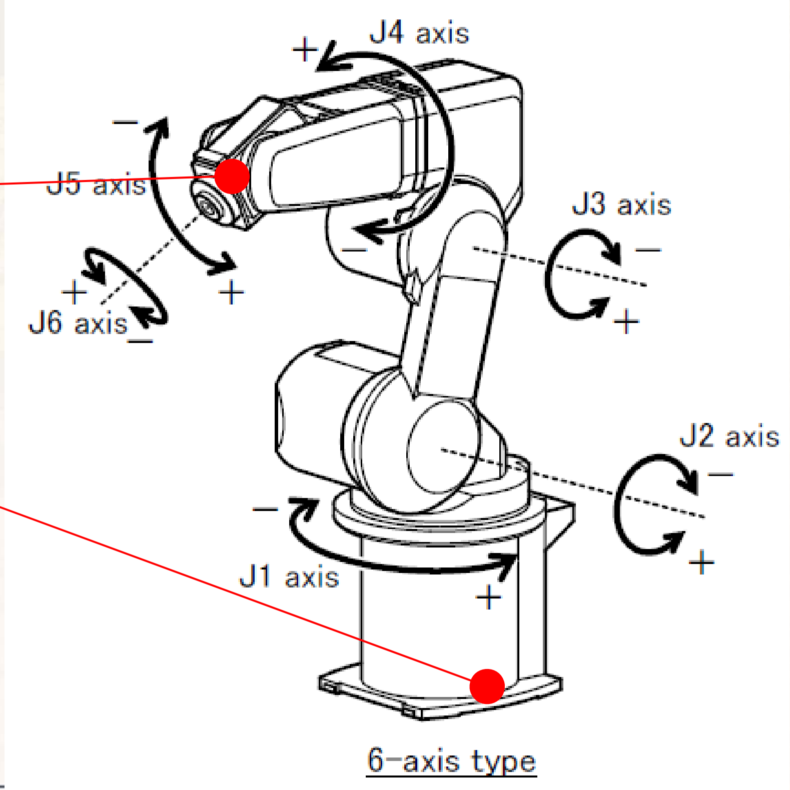


Robot Arm

Physical representation of the Mitsubish RV-3SB robot arm

End-effector

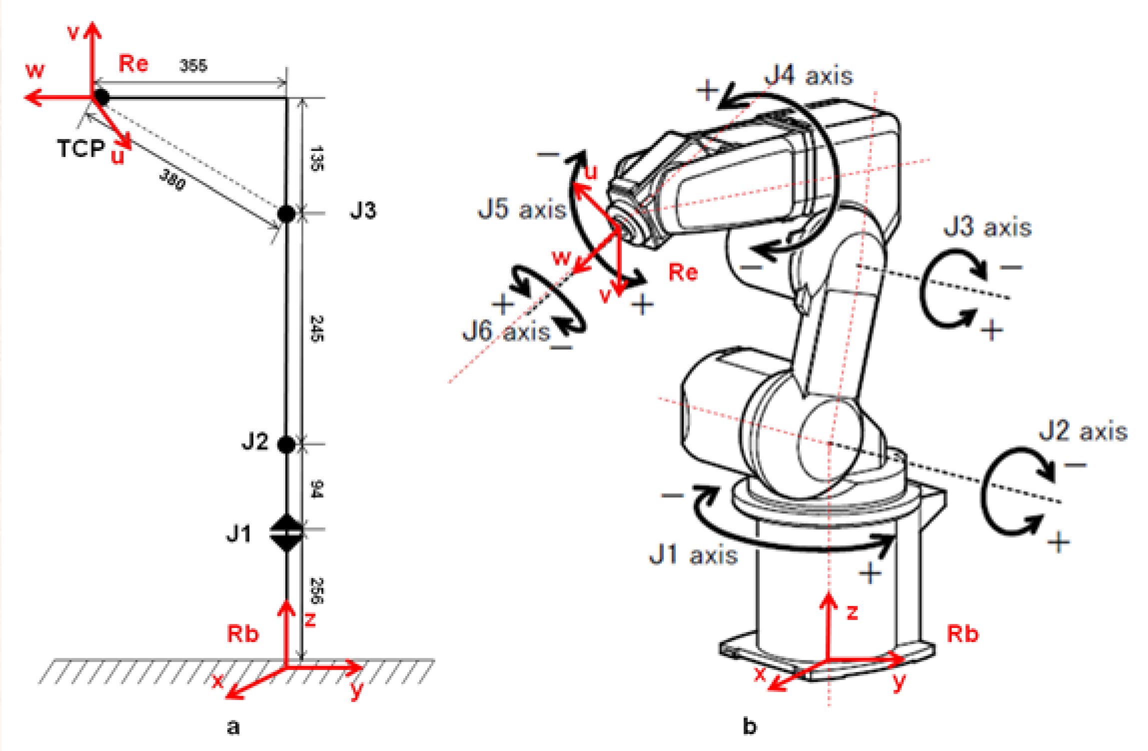
Base



kinematics

- Forward Kinematics
  - Use the joint angles and link lengths of the robot arm to calculate the end-effector
- Inverse Kinematics
  - Given the desired position of the end-effector, the joint angles are calculated

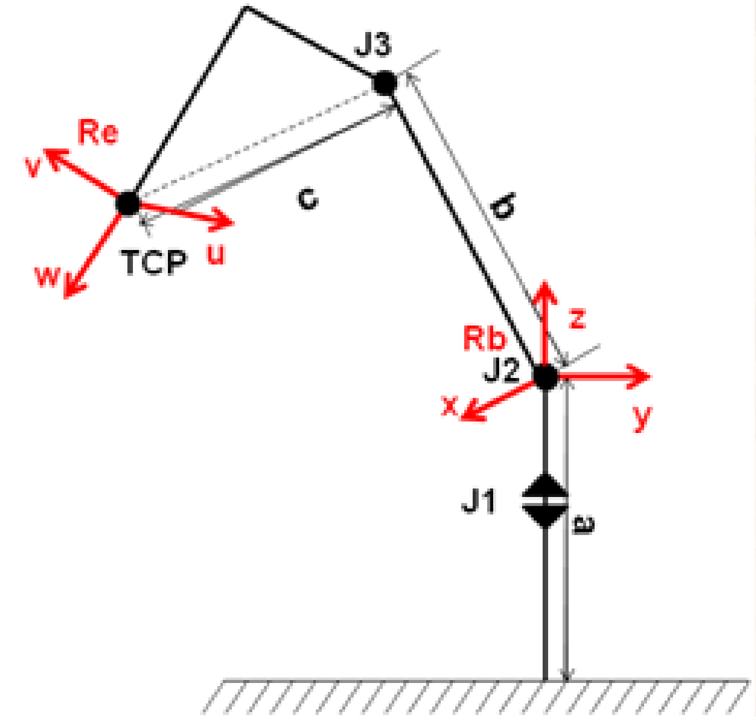
Homogeneous Transformation Matrix



a) Schematic diagram of robot arm; b) Physical representation of the Mitsubish RV-3SB robot arm

Mathematical Model

Forward Kinematics

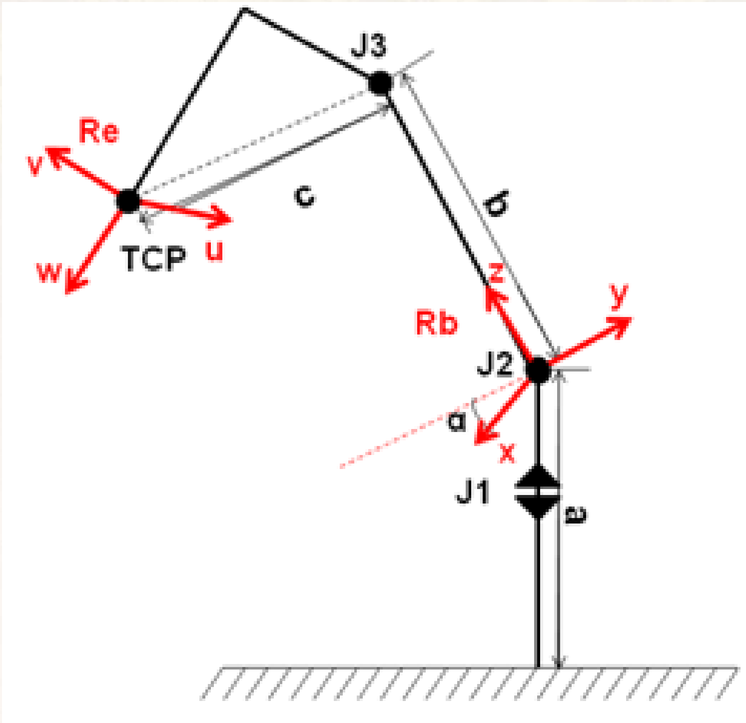


Displacement of Rb coordinates by a distance "a" on the z axis.

$$T1 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & a \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Mathematical Model

Forward Kinematics



Coordinate Rb is rotated around its x axis by an angle α

$$T2 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos(\alpha) & -\sin(\alpha) & 0 \\ 0 & \sin(\alpha) & \cos(\alpha) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

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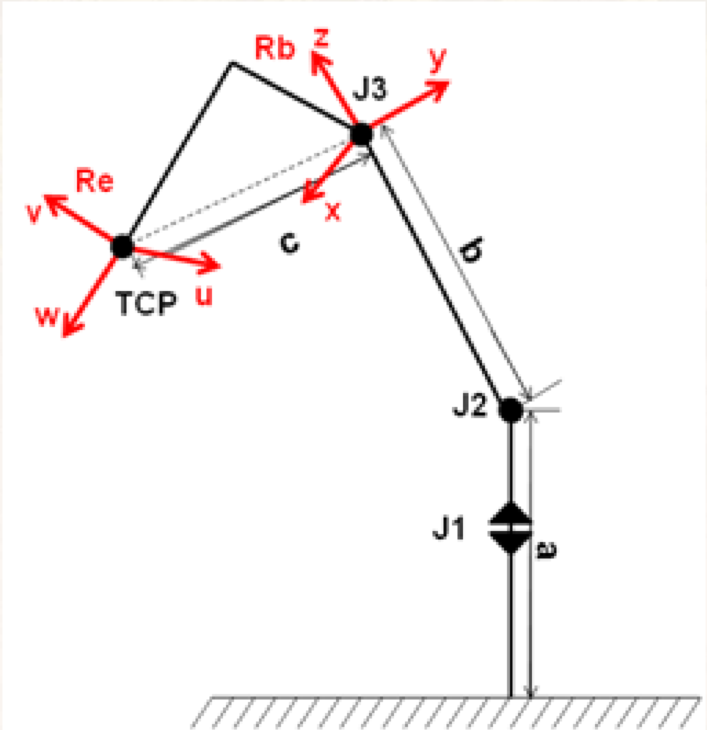
Mathematical Model

Forward Kinematics

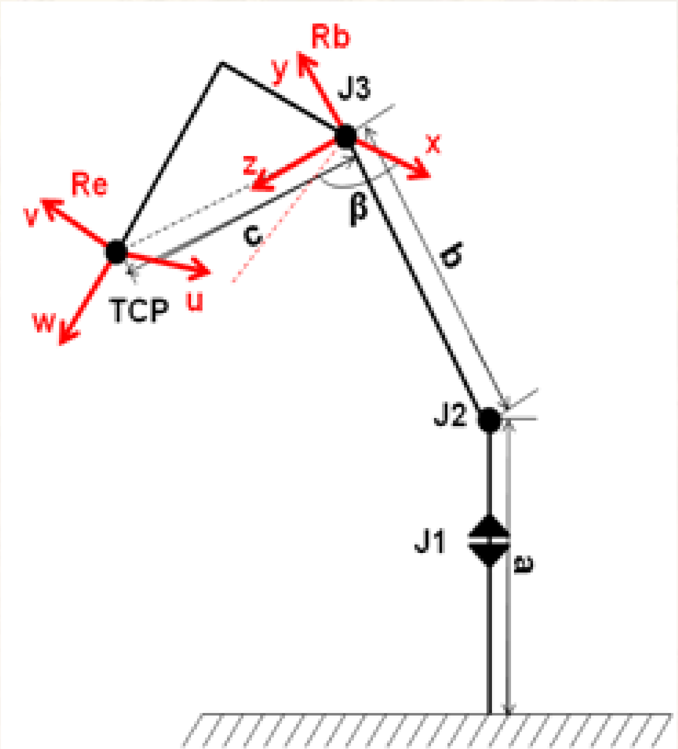


Rb coordinate is shifted by "b" in the direction of its z axis

$$T3 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & b \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Mathematical Model

Forward Kinematics



Coordinate Rb rotated around its x axis by an angle β.

$$T4 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos(\beta) & -\sin(\beta) & 0 \\ 0 & \sin(\beta) & \cos(\beta) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

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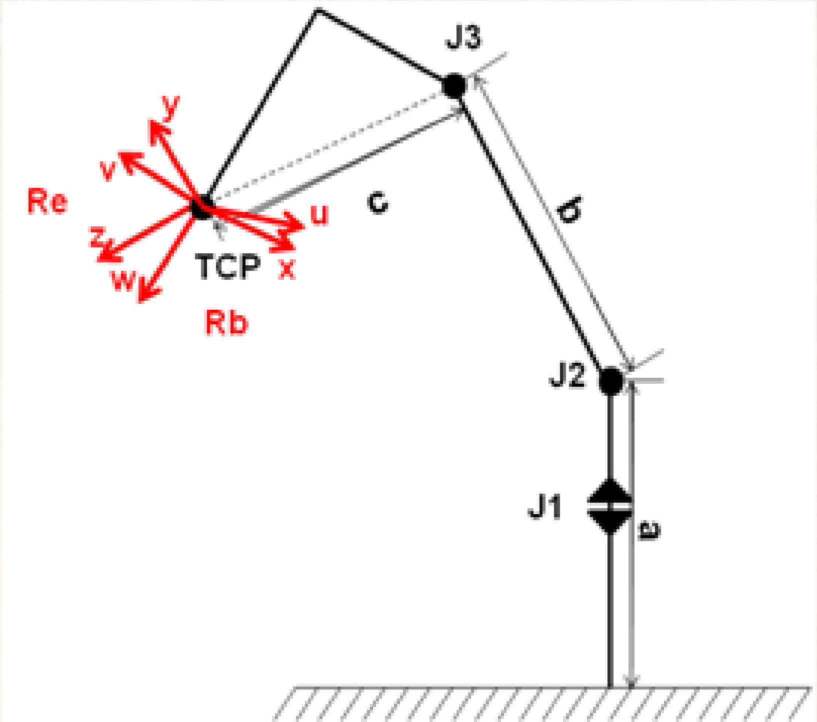
Mathematical Model

Forward Kinematics

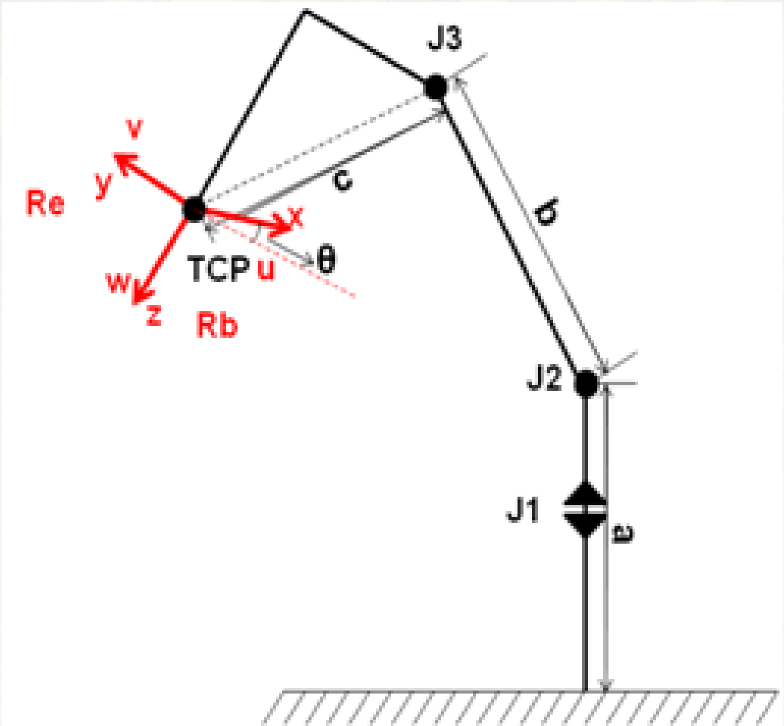


Rb Coordinates shifted by "c" in the direction of its z axis

$$T5 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & c \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Mathematical Model

Forward Kinematics



Coordinate Rb is rotated around its x axis by an angle θ.

$$T6 = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos(\theta) & -\sin(\theta) & 0 \\ 0 & \sin(\theta) & \cos(\theta) & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Mathematical Model

Homogeneous Transformation Matrix

HTM=T1xT2xT3xT4xT5xT6

Software Mathematica

$$HTM = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos(\theta+\alpha+\beta) & -\sin(\theta+\alpha+\beta) & -b\,sin(\alpha) - c\,sin(\alpha+\beta) \\ 0 & \sin(\theta+\alpha+\beta) & \cos(\theta+\alpha+\beta) & a + b\,cos(\alpha) + c\,cos(\alpha+\beta) \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

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