講者簡介

顏家鈺 教授

國立臺灣大學

機械工程學系

顏家鈺教授現為國立台灣大學特聘教授。顏家鈺教授的研究興趣在精密系統之機電整合技術，特別是在奈米操控領域具非常傑出的成果。學術榮譽上曾榮獲國科會與科技部傑出研究獎、科技部特約研究員、ASME Fellow、中國機械工程師學會會士與傑出工程教授、中國自動化科技學會與台灣機器人學會會士、自動控制學會傑出論文獎、台灣大學研究貢獻獎等多項獎項，工業服務方面他曾任工研院光電所顧問、機械所顧問。顏教授亦曾任國立台灣大學工學院院長、機械工程學系系主任、副主任、工學院嚴慶齡工業研究中心主任、副主任、台灣機器人學會秘書長。也曾任中國自動化科技學會理事長、中華工程教育學會秘書長、中國工程學會教育委員會召集人，他也是中國機械工程學會、ASME Taper Chapter、自動化學會、台灣機器人學會等學會的理事。

QUALIFICATIONS

- 加州大學柏克萊分校　機械系系統控制博士
- 明尼蘇達大學　機械系熱流碩士
- 國立清華大學　動力機械系學士

PROFESSIONAL EXPERIENCE

- 奈米操控，嵌入式系統，精密伺服
- 納米操縱，嵌入式系統，高精度伺服

Some Recent Developments in the Industrial Robotic Technology

Jia-Yush Yen, Jin-Shing Chen, Ming-Chih Ho, Yung-Yaw Chen, Han-Pang Huang

Department of Mechanical Engineering,

Department of Thoracic Surgery,

Department of General Surgery,

Department of Electrical Engineering,

National Taiwan University

Outline

- Introduction to recent robot operating environments
- Redundant robot

∆ Two arm robots

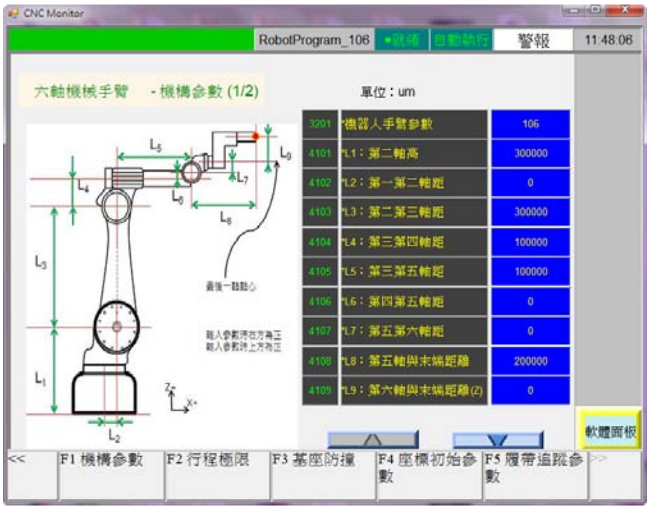
- Human robot co-working
  - Robot task control
  - Human-robot distance calculation
- Demonstrations

ROBOT OPERATING ENVIRONMENTS

SYNTEC SCD-80RA

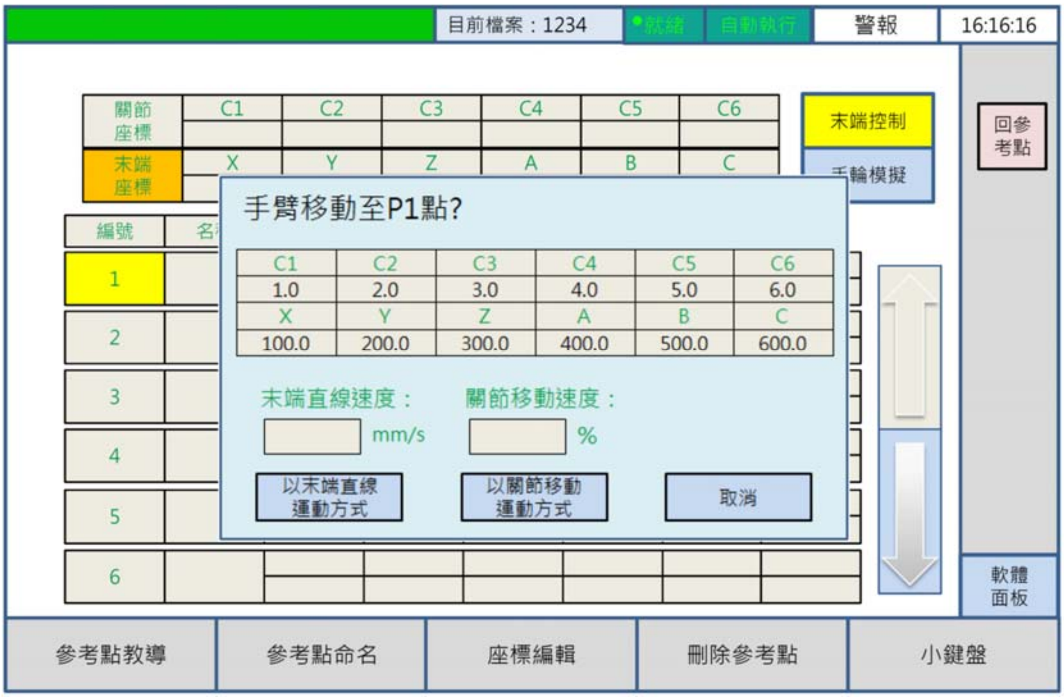
SYNTEC SCD-80RA Control Modules

- Articulated HMI
- Graphical dialogs
- Handheld teaching box
- Visual ready

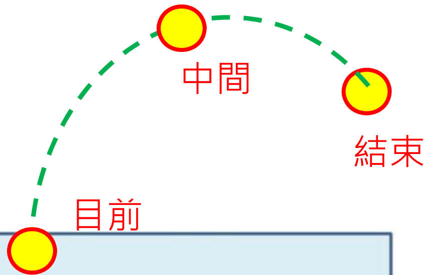


- SYNTEC controller features

- Basic function
- Adding points



- Move



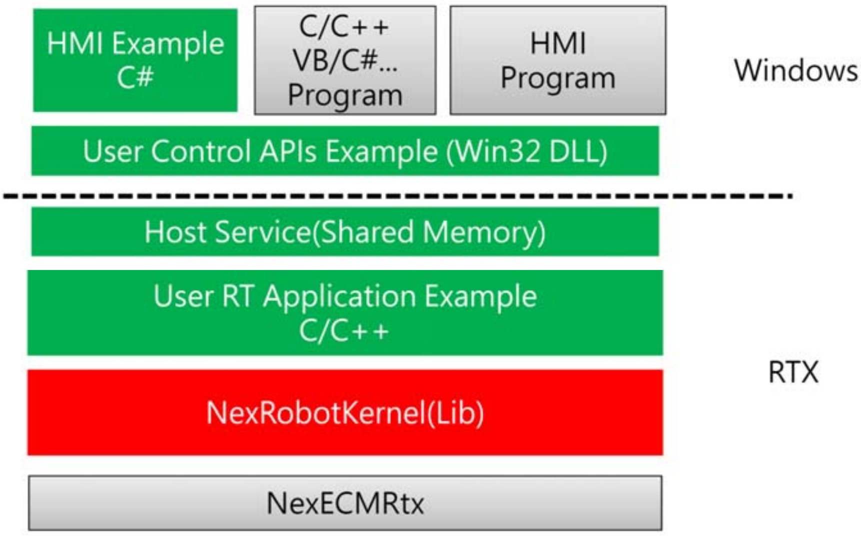
- New features
  - Corner smoothing
  - Compliance teaching
  - Gravity compensation
  - Object weight estimation
  - Vibration supression

NEXCOM NEXROBOTEDU

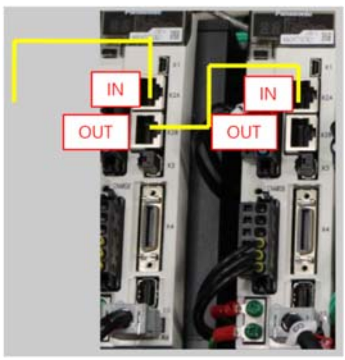
NEXCOM NexRobotEdu

- Robot control software development kit
- Real-time extension (RTX) system
  - Sampling 1 ms
  - Synchronize cyclic position mode
  - Synchronize cyclic velocity mode
  - Synchronize cyclic torque mode

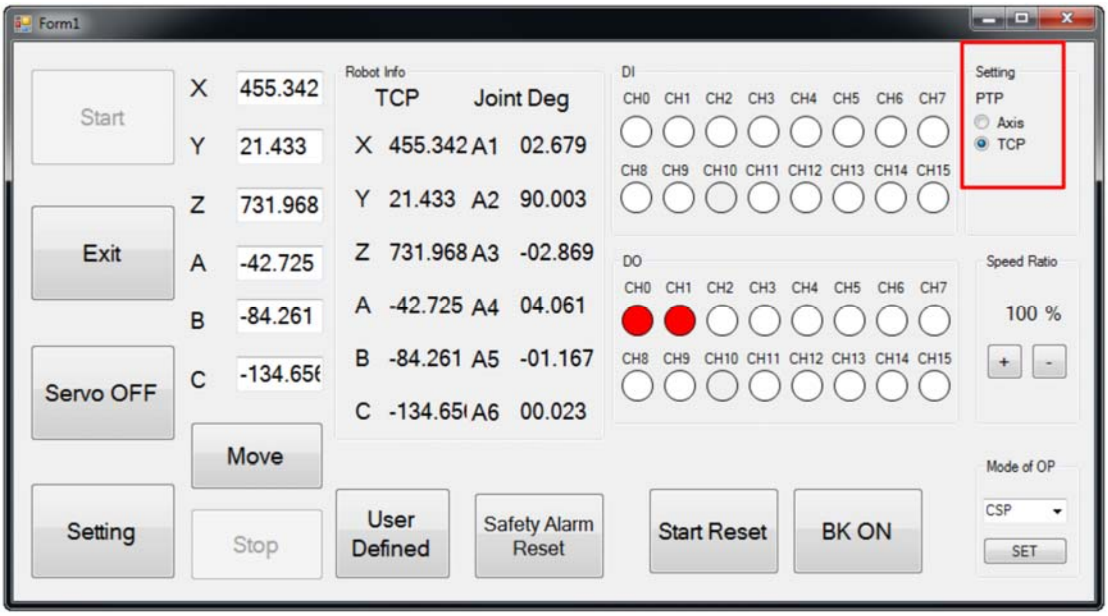
- System block diagram



- EtherCAT interface



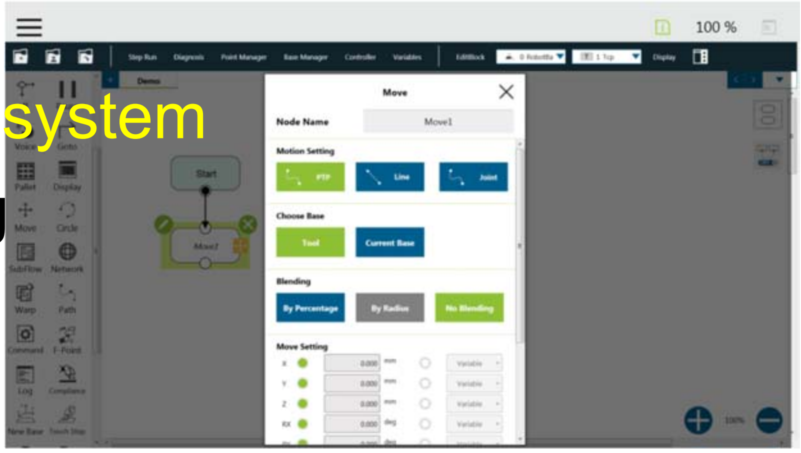
- Operation interface

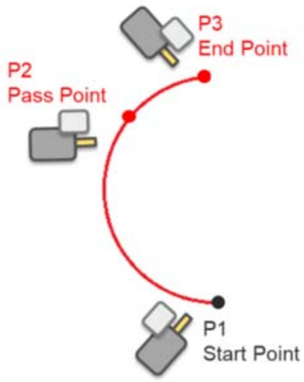


TECHMAN TM5

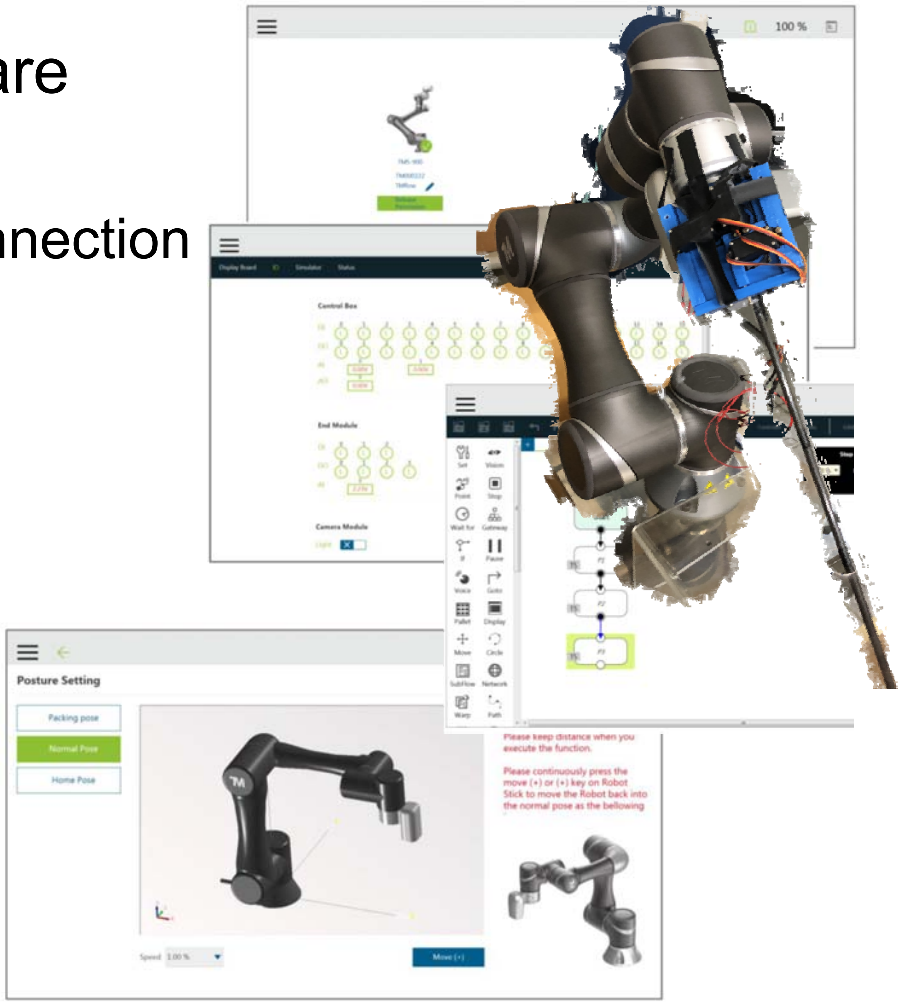
TECHMAN TM5

- Intelligent vision system
- Intuitive teaching
  - Point-to-point
  - Line
  - Blending
- Human-friendly robot

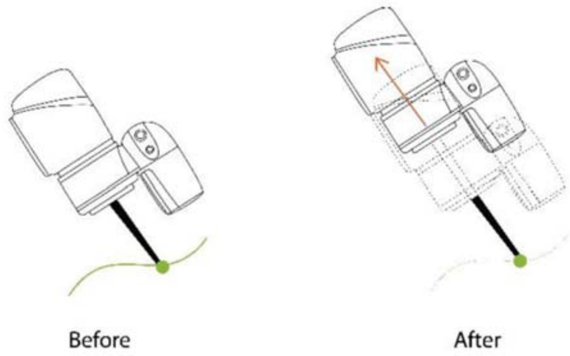




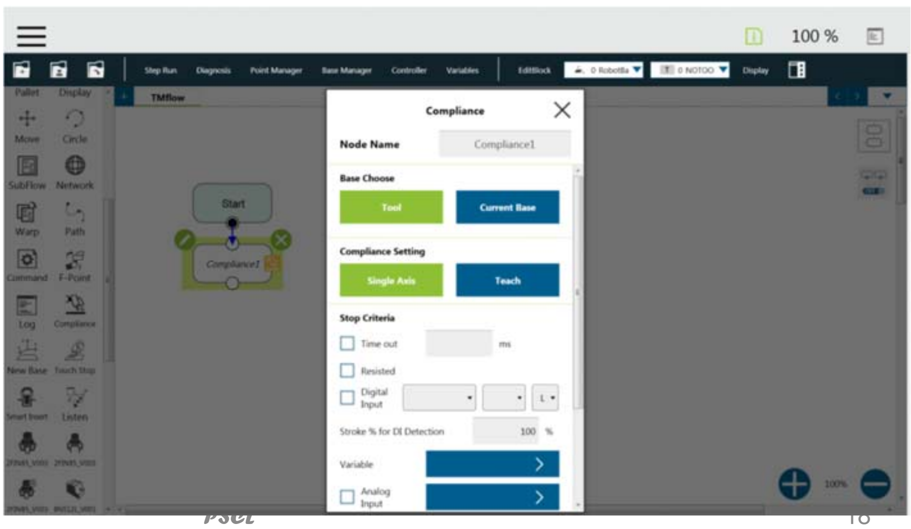
- TM_flow_software
  - Check local connection
  - I/O page
  - Programming
  - Posture setting



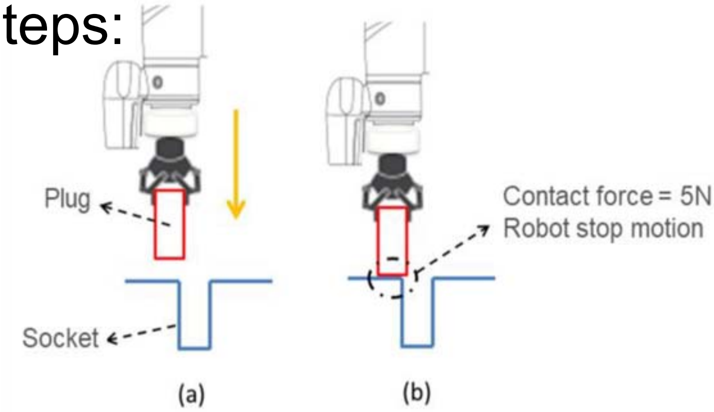
- Eye-in-hand



- Compliance node
  - The Compliance node can set the force limit when the robot moves along a single Base.
  - The user can determine the direction of robot motion based on the Current Base or Tool Base.



- Smart node
  - The SmartInsert Node allows the robot to perform assembly/pushing jobs. The smart design enables difficult object assembly/pushing jobs to be completed through simple and quick setting.
    The pushing action of SmartInsert Node can be divided into three steps:
  - Approaching,
  - Searching,
  - and Pushing .

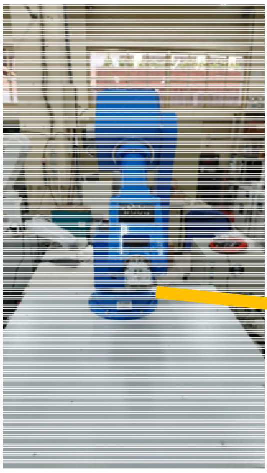


LNC APAC WIN

LNC Robot Arm Controller

控制器

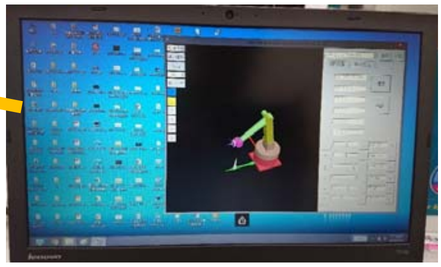
PC(抓取資料，繪製3D模型)



手臂本體

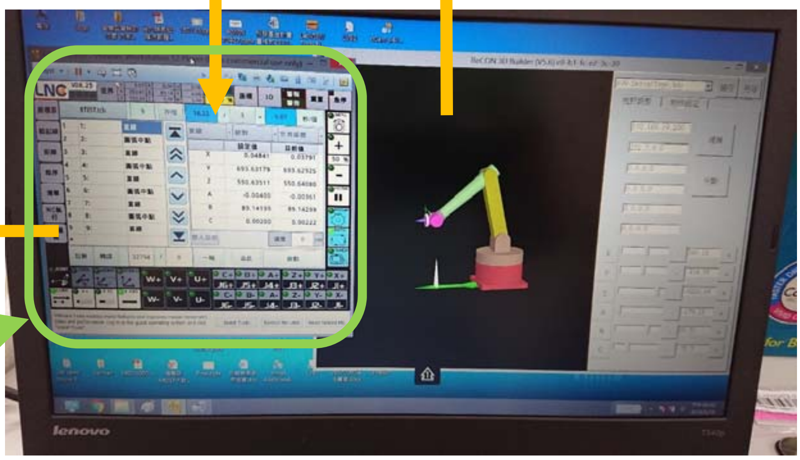
電控箱

使用網路線
與PC連線
TCP/IPv4



機器手臂—模擬架構

抓取資料繪製
3D圖



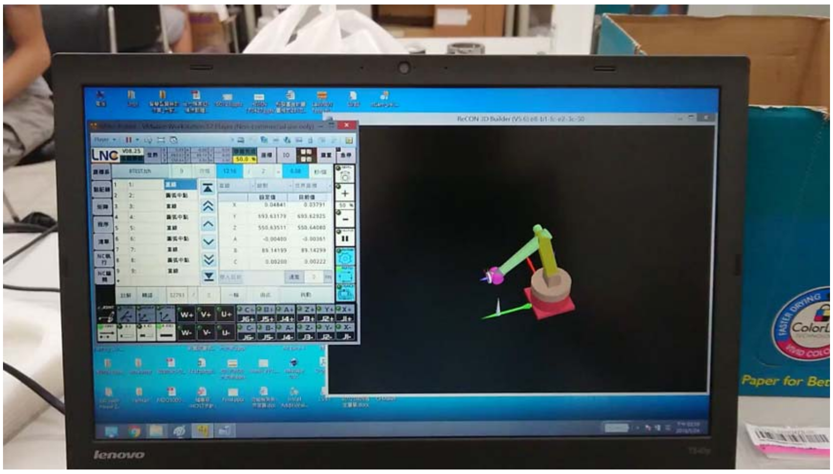
VMware模擬
控制器

程序頁面

機器手臂—模擬手臂運動影片

行走路徑

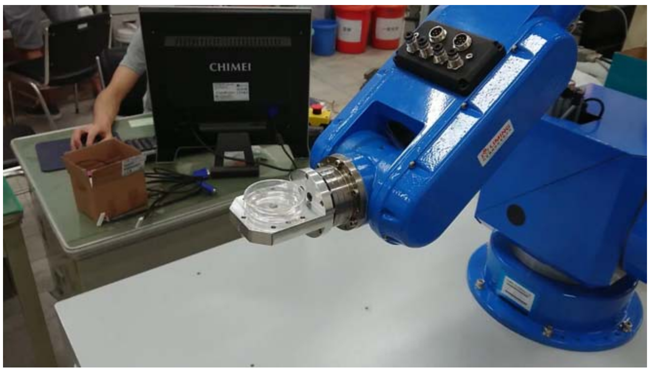
8

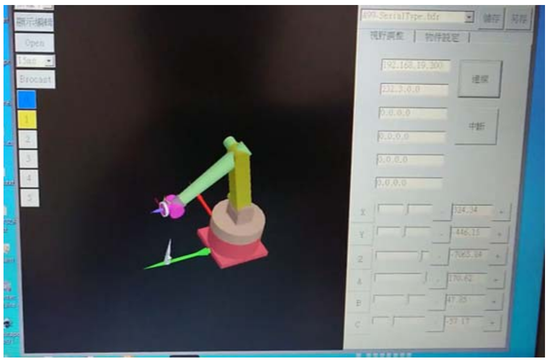


機器手臂—手臂運動影片1

行走路徑

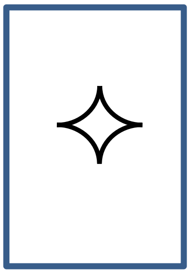
8

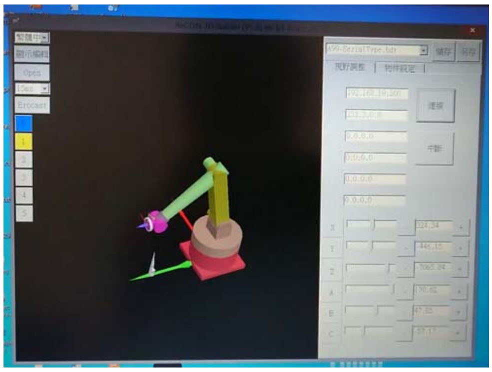




機器手臂—手臂運動影片4

行走路徑





SAFETY REGULATIONS

ISO Standard

TECHNICAL SPECIFICATION

ISO/TS 15066

First edition
2016-02-15

Robots and robotic devices — Collaborative robots

Robots et dispositifs robotiques — Robots coopératifs

- Contents
  - 40 pages

勞動部

- 102 pages

勞動部職業安全衛生署

事業單位實施
協作機器人安全評估報告參考手冊

勞動部職業安全衛生署 編印
中華民國 107 年 12 月

SOME NTU RESULTS FOR DEMONSTRATIONS

Minimally Invasive Surgery at NTU Hospital

Literature Review—Da Vinci Surgical System

- Da Vinci Surgical System [1]
  - The creation of a geometrical and kinematic model of the da Vinci system
  - Remote master control system
  - Too expensive to research

The da Vinci Surgical System is a robotic surgical system made by the American company **Intuitive Surgical**. Approved by the Food and Drug Administration (FDA) in **2000**,

[1] S. Loi-Wah, F. Van Meer, Y. Bailly, and Y. Chung Kwong, "Design and Development of a Da Vinci Surgical System Simulator," in Mechatronics and Automation, 2007. ICMA 2007. International Conference on, 2007, pp. 1050-1055.

AESOP 2000

- Foot pedal, hand, voice control
  - Department of Obstetrics & Gynaecology, University of Kiel, Michaelisstr, Germany (Mettler, Ibrahim, & Jonat, 1998)

Mettler, Ibrahim and Jonat, “One year of experience working with the aid of a robotic assistant (the voice-controlled optic holder AESOP) in gynaecological endoscope surgery,” Human Reproduction, **13**(10), 2748-2750, 1998

- HIWIN Robotic Endoscope Holder

http://www.hiwin.tw/products/me/mtg_h100.aspx

Fixed Orientation Mode 1

Combined Attitude and Position Mode 1 & 2

Chin-Yuan Chen, Jia-Yush Yen

VISION BASED CO-WORKING CONTROL

Drag Teaching

$$\tau = C(q,\dot{q})\dot{q} + G(q)$$

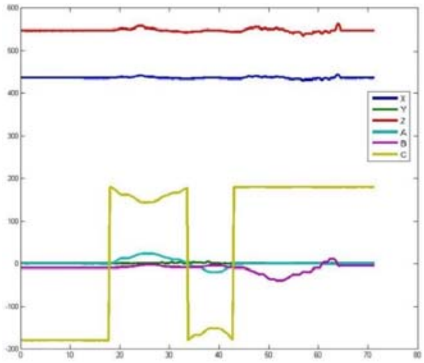
Drag Teaching-Fixed Position

$$\tau = D(q)J^{-1}(a_x - \dot{J}\dot{q}) + C(q,\dot{q})\dot{q} + G(q)$$

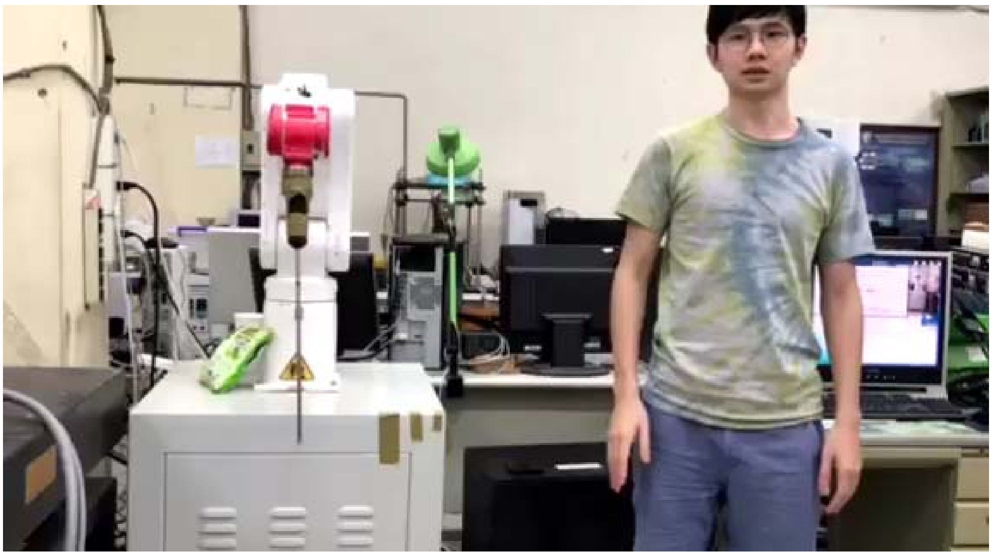
$$a_x = B_t(\dot{X}_d - \dot{X}) + K_t(X_d - X)$$

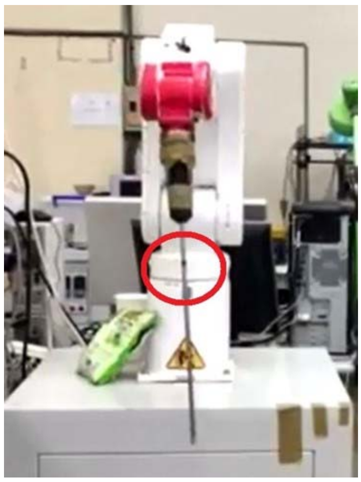
$$B_t = \begin{bmatrix} B & B & B & 0 & 0 & 0 \end{bmatrix}$$

$$K_t = \begin{bmatrix} K & K & K & 0 & 0 & 0 \end{bmatrix}$$

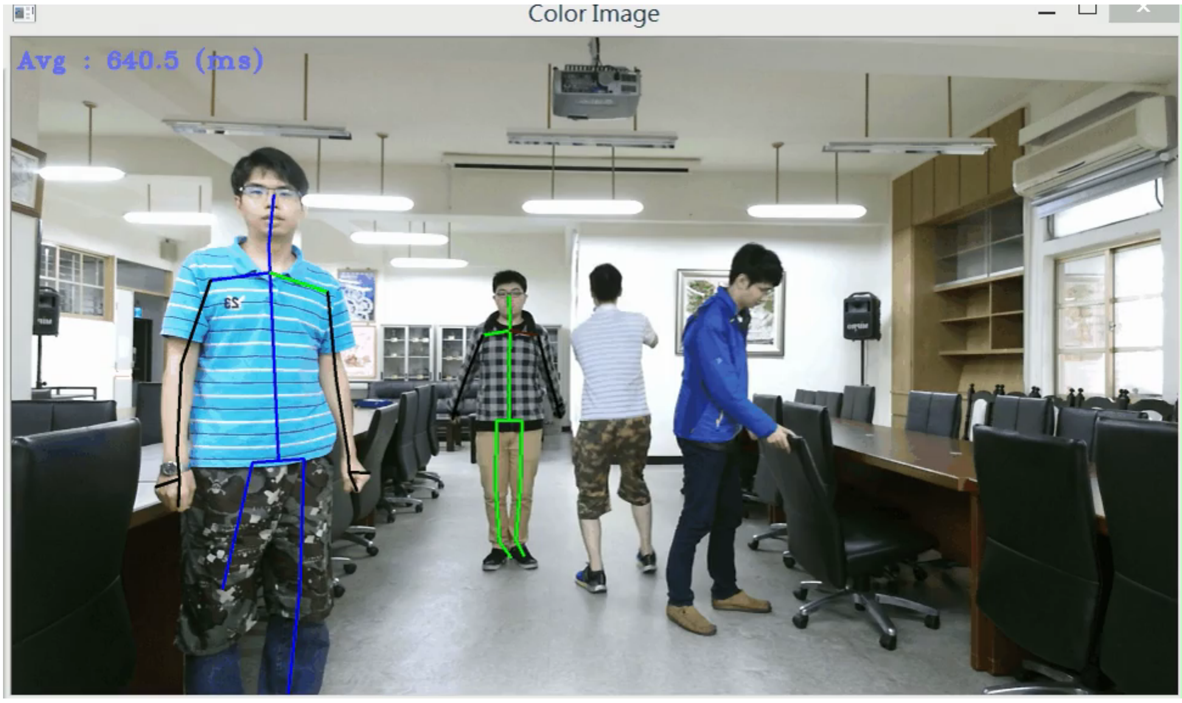


Virtual Compliance Control



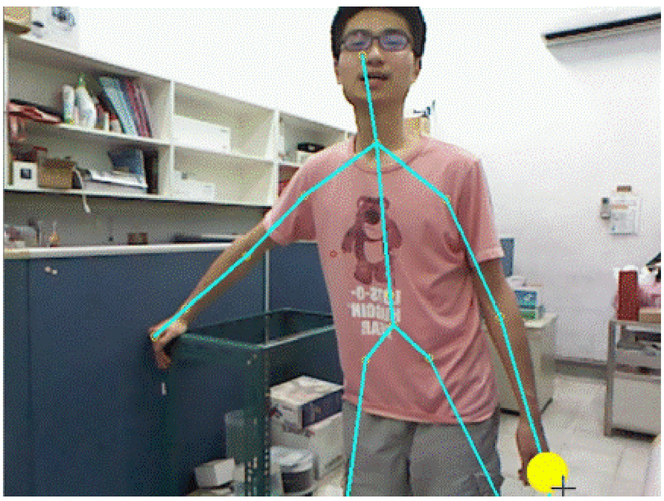


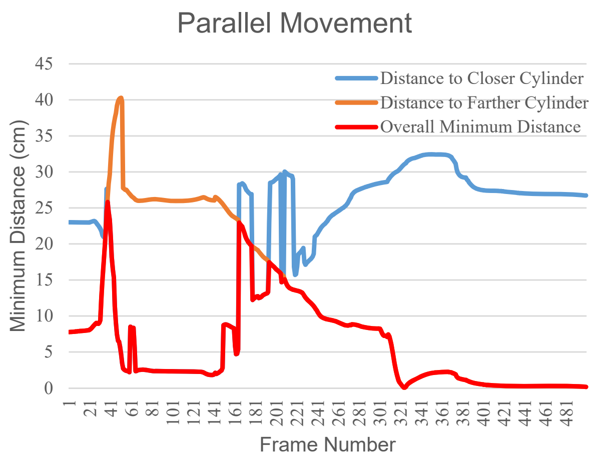
People Detection By Kinet



Experiments – Parallel Imagery Cylinders

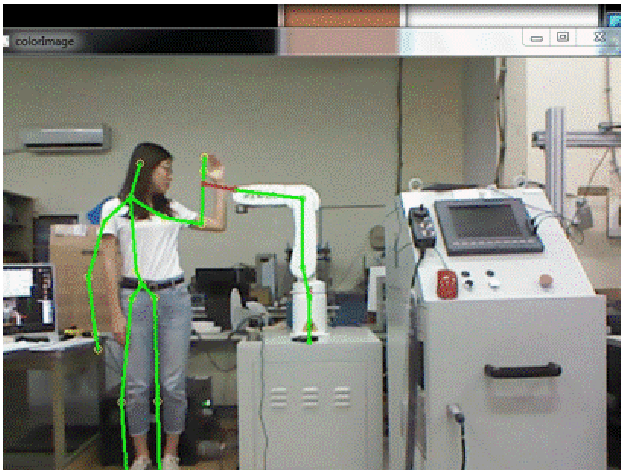
- Cylinder-to-cylinder:

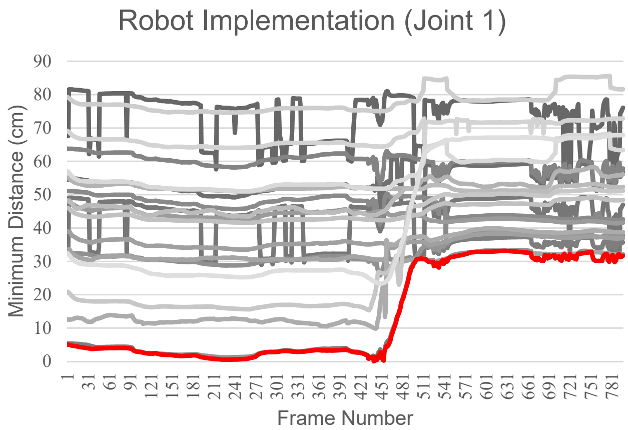




Experiments – Robot Implementation

- Joint 1:





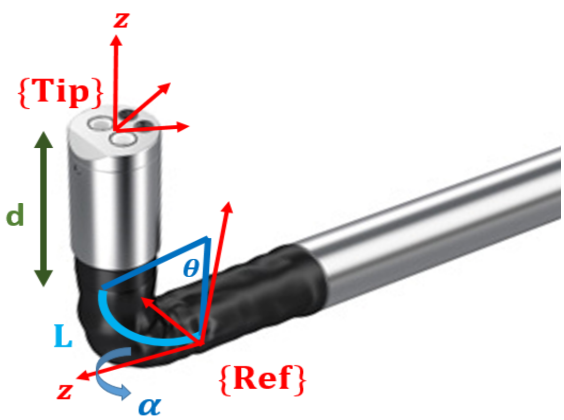
Manipulator Design-Endoscope Model

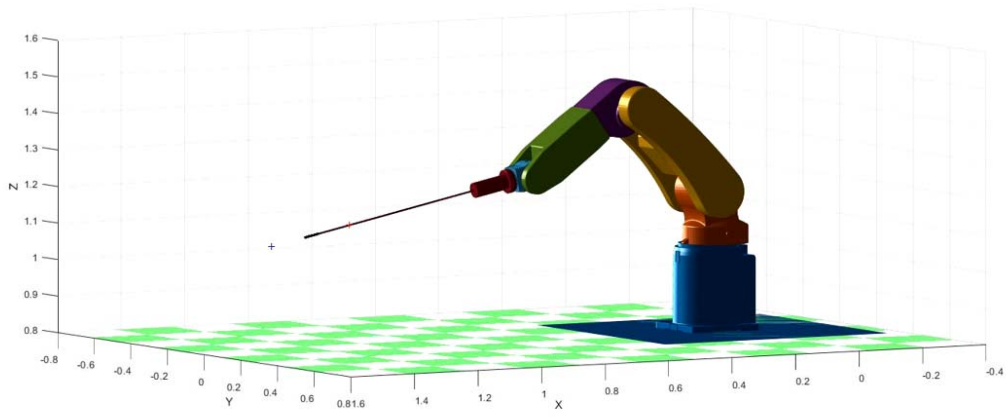
$$ {}^{Ref}_{Tip}P = \begin{bmatrix} X_{Tip} \\ Y_{Tip} \\ Z_{Tip} \end{bmatrix} = \begin{bmatrix} (m(1-\cos(\theta)) + d\sin(\theta))\cos(\alpha) \\ (m(1-\cos(\theta)) + d\sin(\theta))\sin(\alpha) \\ m\sin(\theta) + d\cos(\theta) \end{bmatrix} \qquad m = \frac{L}{\theta} $$

$$ {}^{Ref}_{Tip}T = \begin{bmatrix} R_z(\alpha) & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} R_y(\theta) & p_r \\ 0 & 1 \end{bmatrix} $$

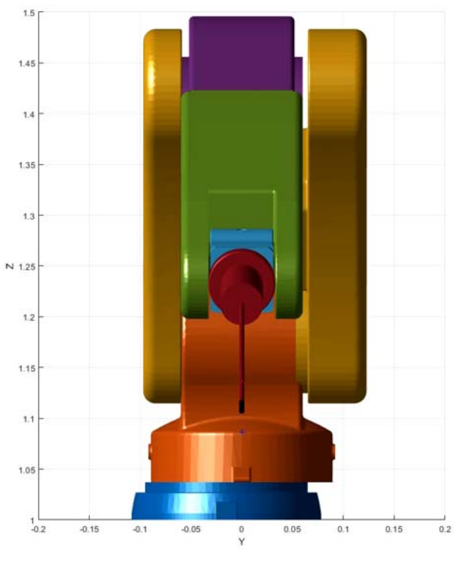
$$ p_r = [m(1-\cos(\theta)) + d\sin(\theta) \quad 0 \quad m\sin(\theta) + d\cos(\theta)]^T $$

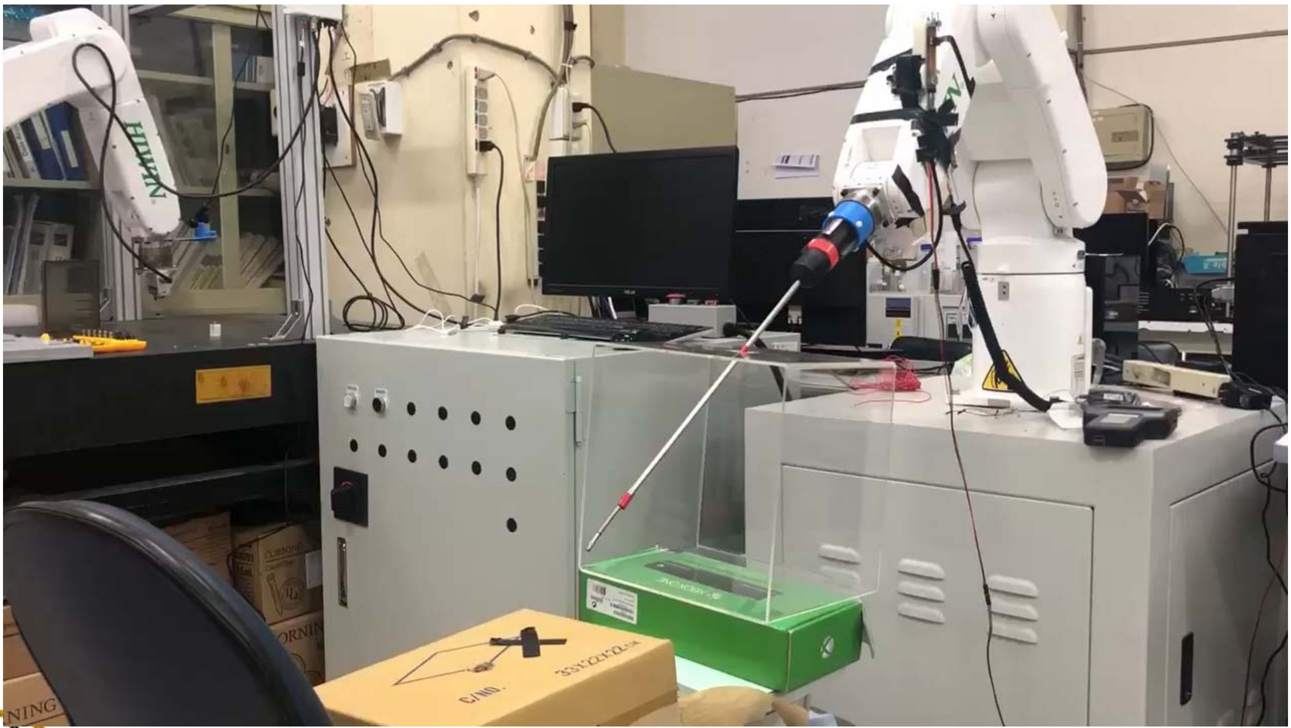
$$ {}^{Ref}_{Tip}T = \begin{bmatrix} c\alpha c\theta & -s\alpha & c\alpha s\theta & X_{Tip} \\ s\alpha c\theta & c\alpha & s\alpha s\theta & Y_{Tip} \\ -s\theta & 0 & c\theta & Z_{Tip} \\ 0 & 0 & 0 & 1 \end{bmatrix} $$

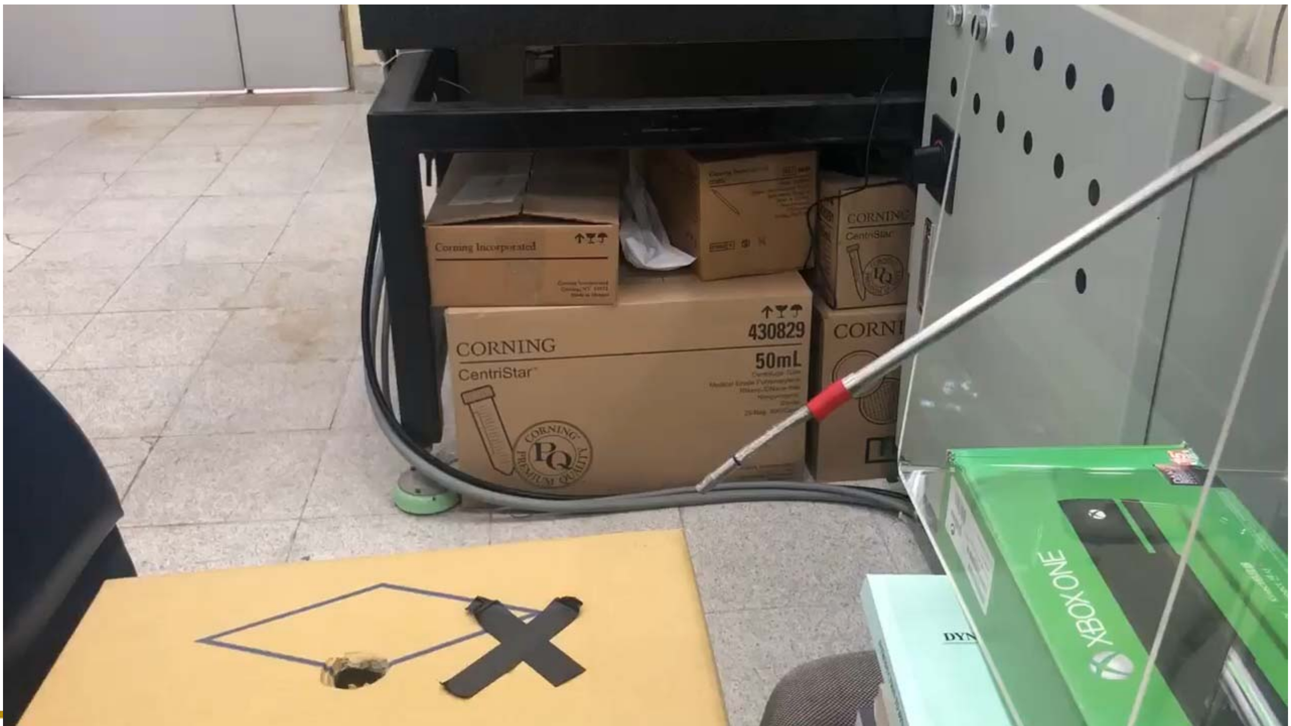




M=0.1 K=5 B=3 Fy=15(N)(t=0~0.5(s)) Fz=-6(t=1~1.5(s))




HIWIN
C/NO.


Corning Incorporated
CORNING
CentriStar
430829
50mL
XBOXONE

Thank for your attention.