協作型機械臂之3D環境感知及工件姿態估測模組

前瞻智慧型機器人模組開發與系統整合

計畫主持人

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執行單位

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計畫簡述

本計畫開發3D視覺模組，發展一套協作型機械臂即時避碰之工件取放控制系統。透過深度學習進行工件辨識，將點雲資料和辨識資訊疊合，分割出工件的點雲資料，估測工件三維姿態，進行取放。在機械臂執行取放任務過程中，當有人員或障礙物進入工作區時，本系統整合機械臂任務軌跡與障礙物閃避運動規劃達到安全抓取。

計劃亮點

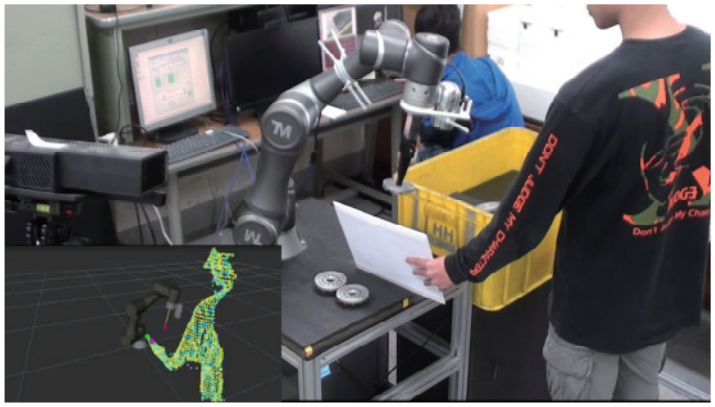
1. 深度學習物件辨識
2. 結合RGB影像與深度影像優化工件姿態估測
3. 即時避障系統

展品規格

1. 工件辨識率: 97%
2. 工件姿態估測平均誤差: 0.83 mm, Orientation: 0.70。
3. 平均估測時間: 1.1 Sec
4. Pick and place cycle time: 14.5 Sec

產業應用

協作型機器人讓產線中的機械臂可以與人類共存在同一個工作空間，讓機械臂結合人類的高彈性，提升工作效率與品質。一般協作型機械臂的3D視覺抓取能力較為不足，難以應付任意堆疊的工件抓取任務，因此需藉由RGB-D攝影機結合物件辨識與姿態估測演算法強化3D視覺抓取能力。



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MOST 科技部
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科技部智慧機械創新館

Development of a 3D Environment Perception and Object Pose Estimation Module for Collaborative Robots

Module Development and
System Integration of Aadvanced Robots

Principal Investigator

Prof. Kai-Tai Song

Introduction

This project aims to develop a 3D vision module for real-time obstacle avoidance and bin-picking of collaborative robots. A RGBD camera recognizes the object using deep learning technics. When objects are located by the DNN, the RGB image and the point cloud data are aligned for pose estimation. Depth cameras installed in the environment monitor the robot working space. Once there is an obstacle or a person in the working space, the system generates a collision-free path to avoid obstacles and continues to complete the pick-and-place task.

Industrial Applications

Collaborative robots allow the robot arm and human to work in the same working space, improving the work efficiency and quality. The Developed 3D vision system deals with the random bin-picking task. Therefore, the RGB-D camera combined with the object recognition and pose estimation algorithm is required. With real-time 3D image tracking, active obstacle avoidance is implemented on a robot to monitor changes in the environment and plan a collision-free path for the robot.

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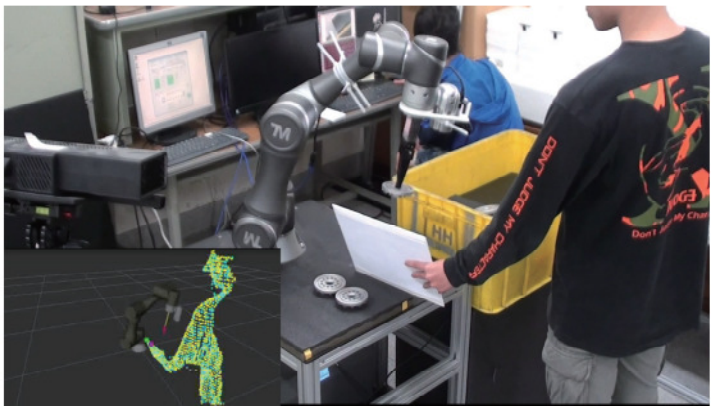
Highlights

1. Deep learning for object segmentation
2. 3D object pose estimation
3. Real-time obstacle avoidance

Specification

1. Object average recognition rate: 97%.
2. Object average pose estimation error : 0.83 mm in translation and 0.70 degrees in orientation.
3. Average recognition time : 1.1 Sec
4. Pick and place cycle time: 14.5 Sec



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科技部智慧機械創新館

先進智慧型機器人光學精密量測模組開發與系統整合

前瞻智慧型機器人模組開發與系統整合

計畫主持人/共同主持人

陳亮嘉教授 / 鍾添東教授、
林志哲教授、蕭金廷教授

計畫簡述

本計畫期待發展出可對具高複雜性幾何形貌工件或機件模組，在其產品設計最佳化階段或在線上製程品管中，對工件進行自動化之高速非接觸三維形貌精密量測、關鍵尺寸萃取、精密空間資訊偵測(位置與姿態)、快速形貌誤差與瑕疵檢測以及具複雜性多工件之自動化辨識。

產業應用

1. 為將來智慧型工廠在智慧視覺4.0 上之需求奠定基礎
2. 工件、物件之精密姿態與空間三維位置光學偵測能力
3. 機器手臂End effector 空間位置與姿態之精密光學校正技術與系統 （專利）
4. 可應用於產品設計開發階段之評估與最佳化
5. 應用於製造階段之線上即時光學量測品管監控
6. 將技術運用於醫學工程之健康監控(如糖尿病患之傷口的復原監控、早產兒或嬰幼兒之健康安全監控)等。

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執行單位

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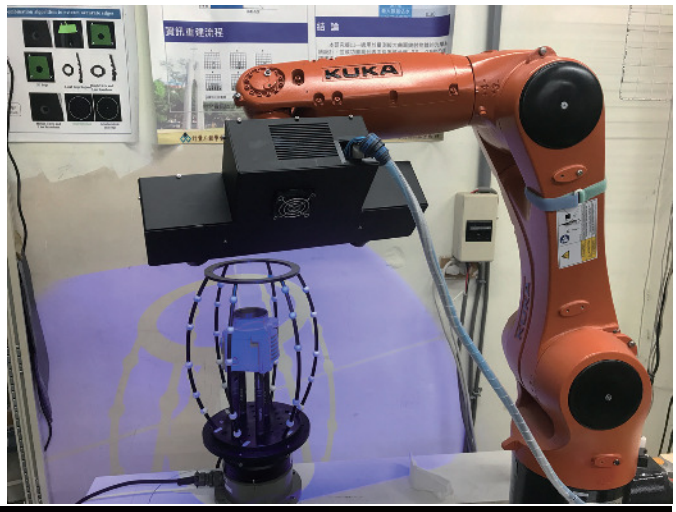
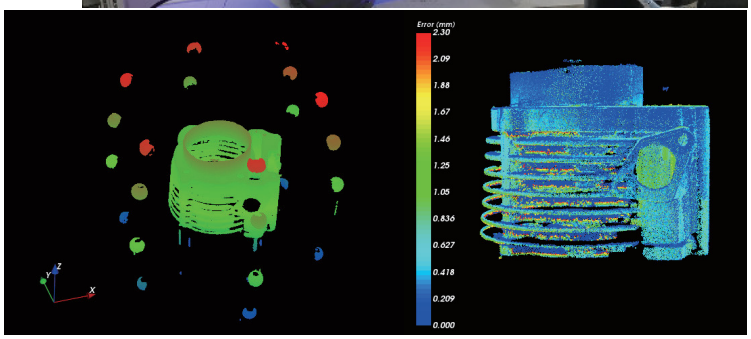
計劃亮點

1. 光學三維形貌量測探頭模組與演算法之發展
2. 發展系統校正方法與量測資料精密縫合技術
3. 機器手臂之空間定位精密校正技術

展品規格

1. 重覆度: 150 μm @ 2σ of 100 mm
2. 景寬(F.O.V): 370 × 260 mm
3. 深度解析: 75 μm of 100 mm





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科技部智慧機械創新館

Development of Advanced Intelligent Optical Precise Measuring Module and System Integration with 6-Axis Robots

Module Development and
System Integration of Aadvanced Robots

Principal Investigator / Co-PI

Prof. Liang-Chia Chen / Prof. Tien-Tung Chung, Prof. Chih-Jer Lin, Prof. Chin-Ting Hsiao

Institution

National Taiwan University / Department of Mechanical Engineering

Highlights

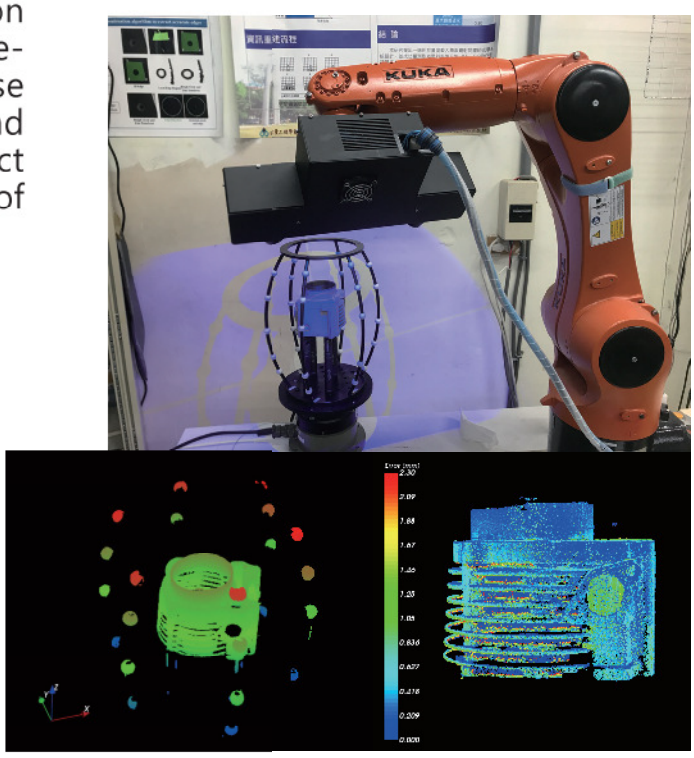
1. Development of optical three-dimensional shape measurement probe module andalgorithm.
2. Development of system calibration method and measurement data precision stitching technology.
3. Precise space positioning calibration technology for robot arm.

Introduction

The project is expected to develop high-speed non-contact three-dimensional topography that can automate the workpiece with high complexity and geometric design in the process of optimizing the design of the workpiece or in the stage of product design optimization or on-line process quality control. Measurement, critical dimension extraction, precise spatial information detection (position and attitude), rapid profiling error and defect detection, and automated identification of complex workpieces.

Specification

1. Repeatability: 150 μm @ 2σ of 100 mm
2. F.O.V: 370 × 260 mm
3. depth resolution: 75 μm of 100 mm



Industrial Applications

A Laying the foundation for the future demand of smart factories in Smart Vision 4.0.
B Applicable to the evaluation and optimization of the product design and development stage.
C Online real-time optical measurement product monitoring used in the manufacturing stage.
D Apply the technology to the health monitoring of medical engineering (such as the recovery monitoring of wounds in diabetic patients, the health and safety monitoring of premature infants or infants).

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科技部智慧機械創新館

骨科微創手術機器人之階層式多感測器融合主僕控制模組開

前瞻智慧型機器人模組開發與系統整合

計畫主持人

顏炳郎教授

執行單位

國立台灣大學 / 生物機電工程學系

計畫簡述

本計畫開發手持式手術機器人系統，作為輔助醫師進行微創手術重要平台，並以手持式機器人之階層式多感測器融合主僕控制模組為主要開發標的，當中包含內嵌控制韌體與手術導航軟體，手術導航軟體可進行術前規劃模擬與術中機器人導航，內嵌控制韌體則進行機器人之路徑規劃，軌跡規劃與運動控制，達成導引定位循跡與手顫補償等功能。

計劃亮點

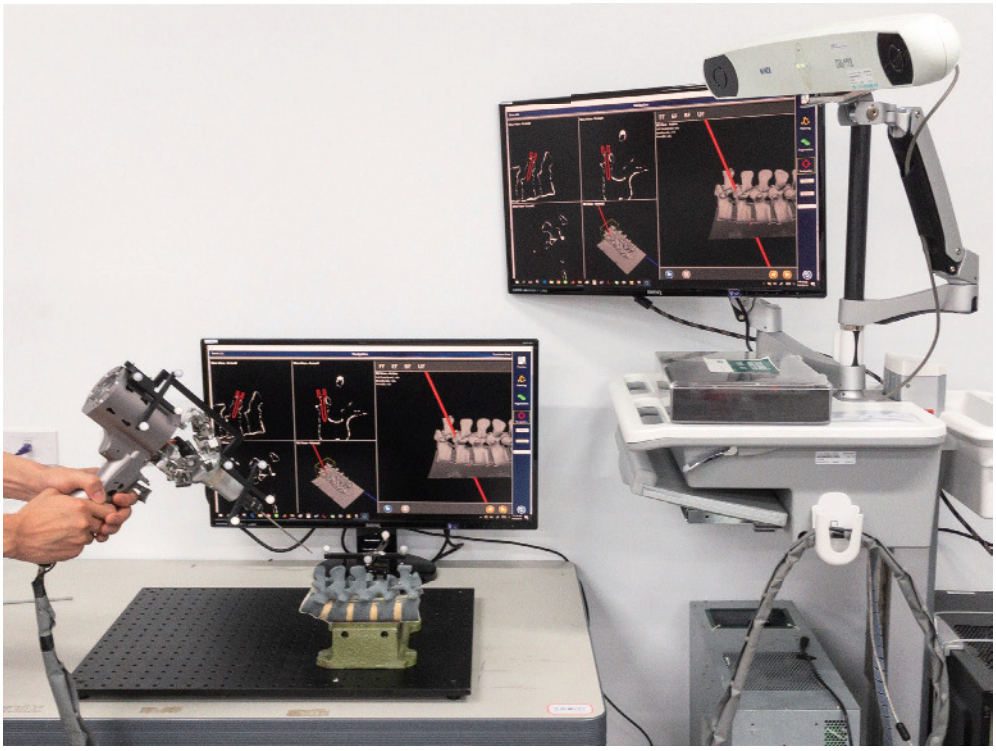
1. 醫師手顫抑制。
2. 人機協同特色。
3. 體積小與方便使用。

展品規格

1. 術前規劃軟體與人機協同控制之術中導航圖控介面。
2. 手持機器人手術手顫補償與目標追蹤。

產業應用

手持式機器人手術系統可應用於骨科微創手術，如骨科之椎弓釘融合，髓內釘固定，關節置換與韌帶重建等以微創方式之手術。



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Development of a Hierarchical Multisensor-Fused Master/Slave Control Module for a Minimally Invasive Orthopedic Surgical Robot

Module Development and System Integration of Aadvanced Robots

Principal Investigator

Prof. Ping-Lang Yen

Institution

National Taiwan University / Department of Biomechatronics Engineering

Introduction

A hierarchical multi-sensor fusion master/slave control module, which consists of robot controller and navigation software. The control module provides a pre-operative surgical planning and intra-operative navigation interfaces for the operator, and a motion controller which calculates the optimal path, trajectory planning and servo controller for the robot. The overall robot system can achieve auto-tracking of the surgical tool and tremor suppression from the operator, thus provides very unique features of ease-of-use to the product.

Highlights

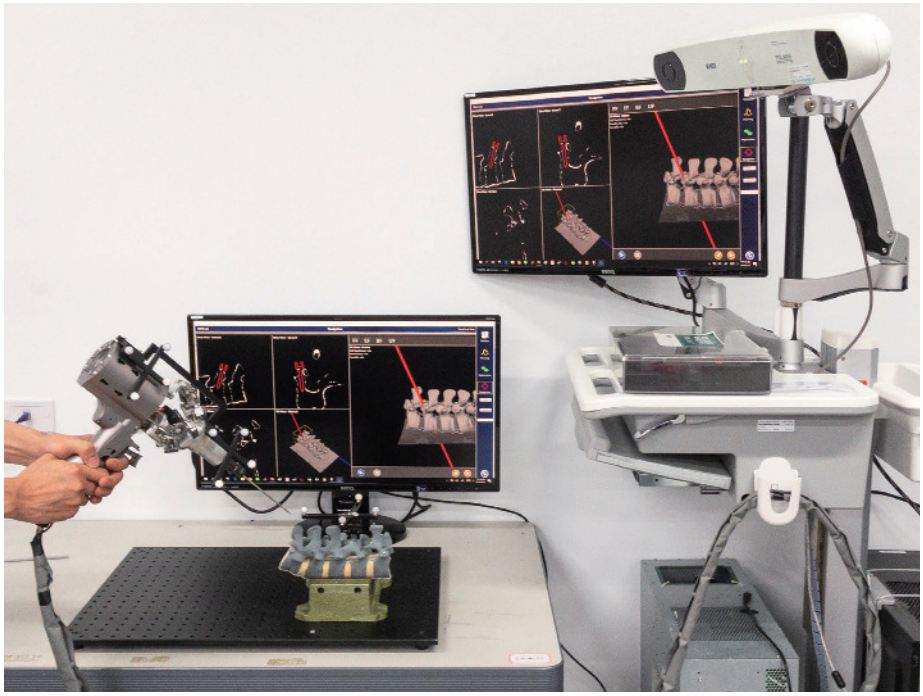
1. Tremor suppression.
2. Human robot collaboration.
3. Small footprint and easy to use.

Specification

1. Surgical planning and navigation graphics for human robot collaboration.
2. Target tracking and tremor suppression of the surgical tool.

Industrial Applications

The handheld robot surgical system can be utilized in minimally invasive surgical procedures, such as pedicle screw fixation, Intramedullary nail fixation, joint replacement and soft tissue reconstruction.



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