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- 平台定位策略Analysis, Design and Control of Stage
- 機器人相關研究(全向輪、飛行器)
- 室內定位相關研究(Wiimote、Smart Floor)
- 金屬3D列印週期性結構ANSYS力學分析
- 化學強化玻璃之雷射加工檢測
- 模態分析研究
- 3C 裝置失效分析與可靠度方面研究

# Fracture Simulations and Parametric Study of Elastic Structures



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National Cheng-Kung University, Tainan, Taiwan

**Sep. 10, 2015**



# Fracture Analysis in Elastic Structure

- ◇ Crack propagation
- ◇ Creep and fatigue

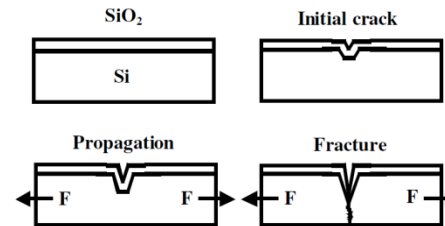
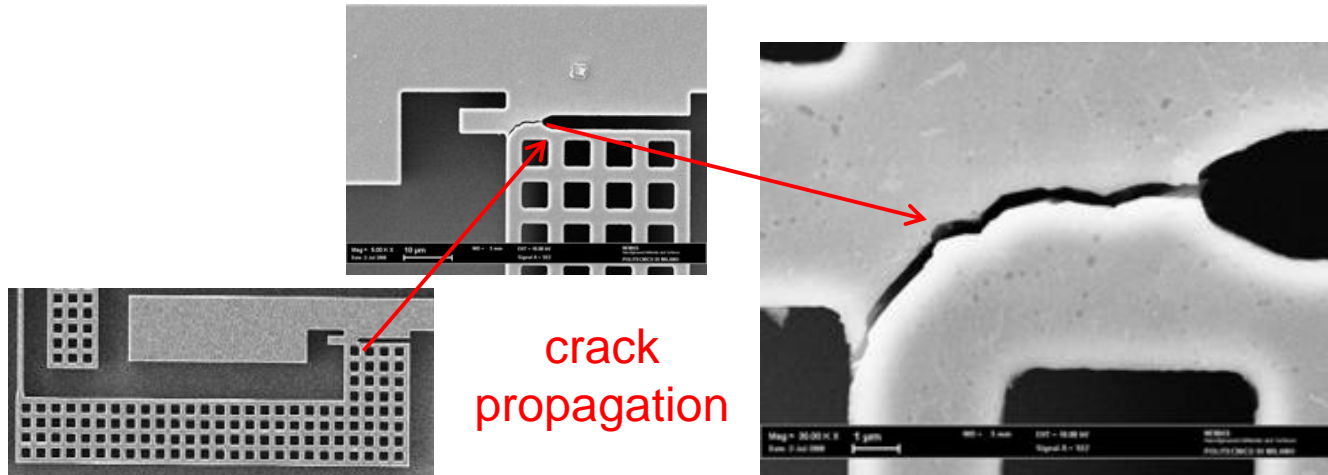


Fig. 8. SSC failure mechanism in silicon.





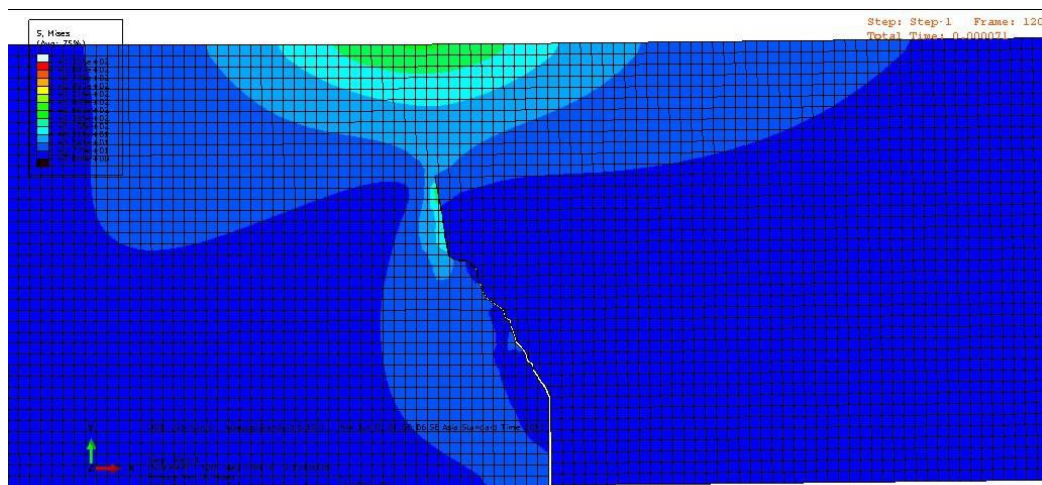
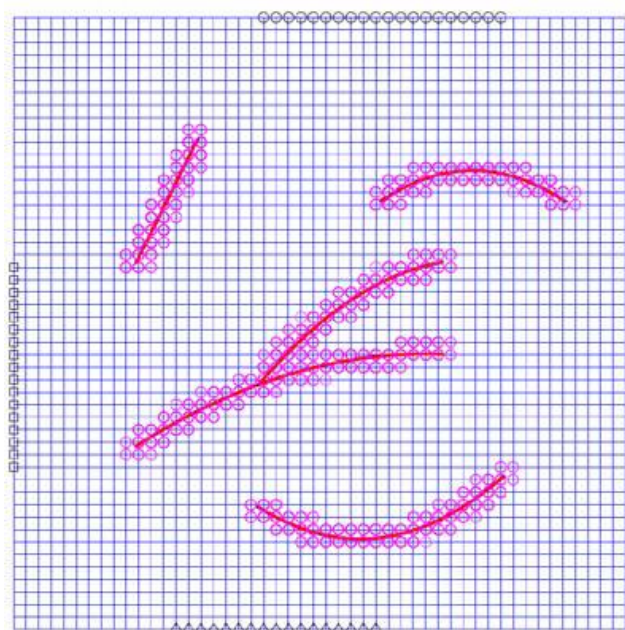
# Directions

- ◆ Implementation of fracture analysis package in Abaqus (e.g. XFEM...) to easier predict the complicated behavior (composite material, complicated geometry, multi-crack...;) of fracture
- ◆ Apply these models on real engineering scenario (MEMS design, manufacturing...)



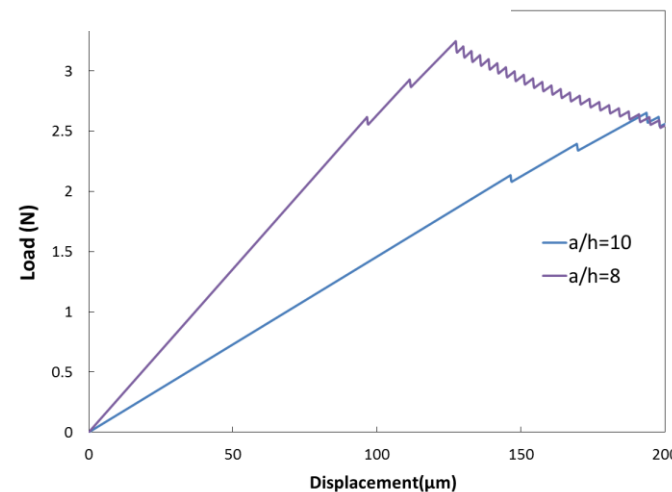
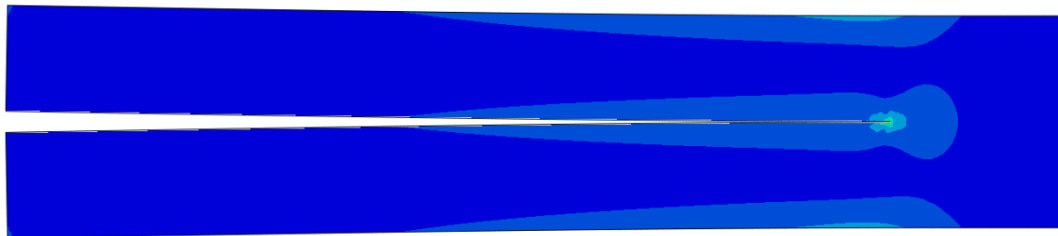
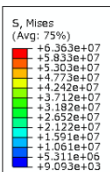
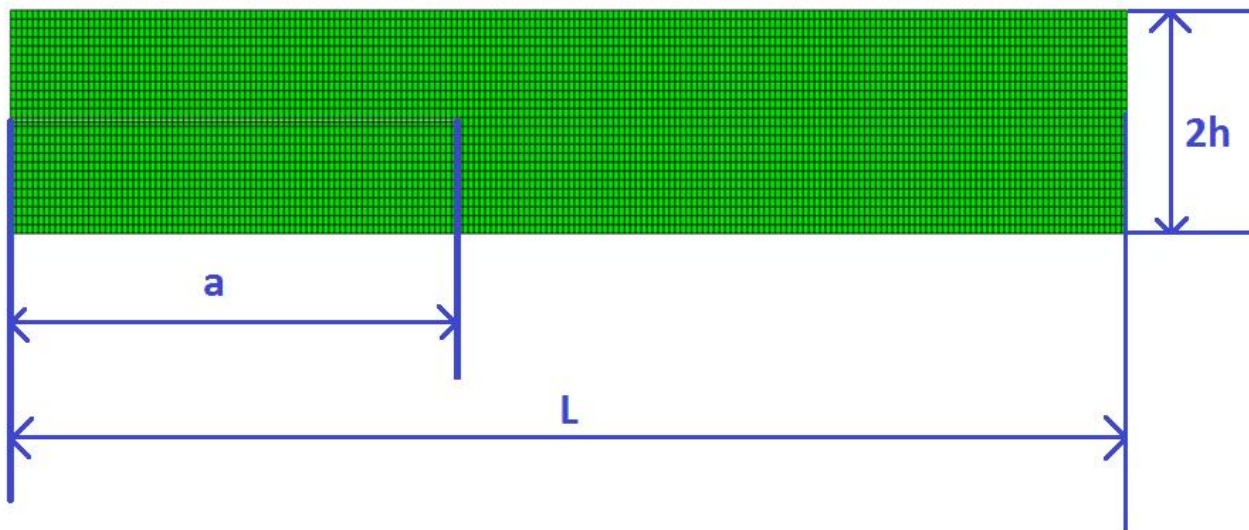
# Extended Finite Element Method(XFEM)

- ◆ Adding discontinuous enrichment into elements
- ◆ No need to remesh
- ◆ The freedoms of crack growth is higher



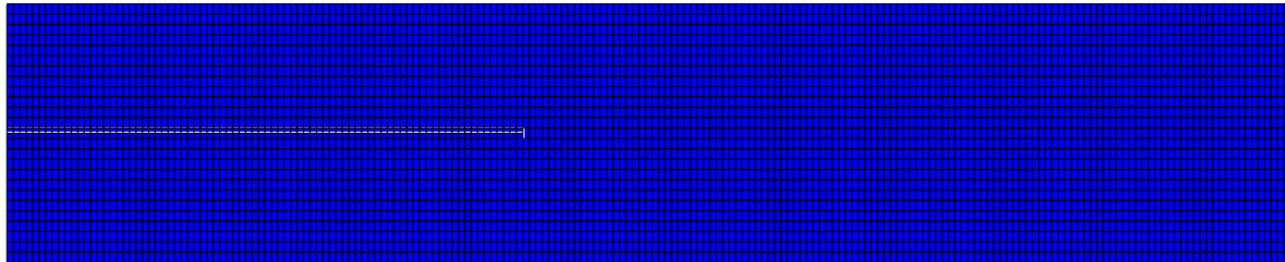
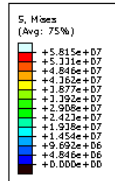


# Benchmark: DCB test simulation



# Animation of DCB

Step: Step-1 Frame: 0  
Total Time: 0.000000



3D Double cantilever beam test model  
ODB: dcb\_x fem.odb Abaqus/Standard 6.10-1 Tue Oct 07 04:05:38 GMT+08:00 2014



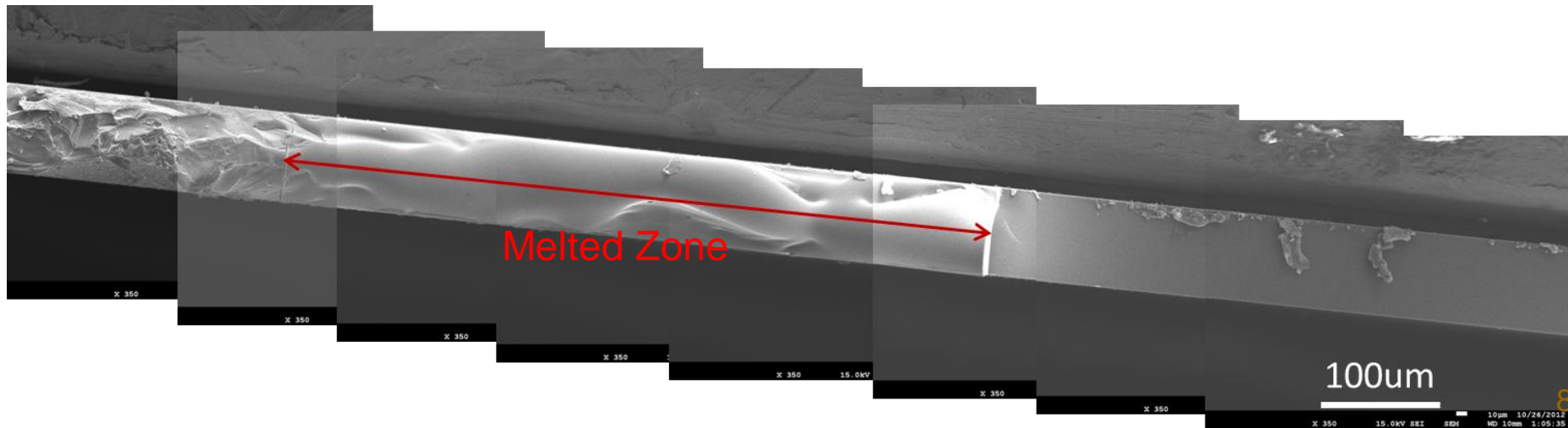
Step: Step-1  
Equipment: D Step Time = 0.000  
Primary Var: S, Mass  
Deformed Var: U Deformation Scale Factor: +1.000e+00





# Application: Laser Peeling

When a heat source (laser) move on glass, the surface will be melted. The phase change of surface will generate a contract tensile stress on initial crack, then peeling is caused.





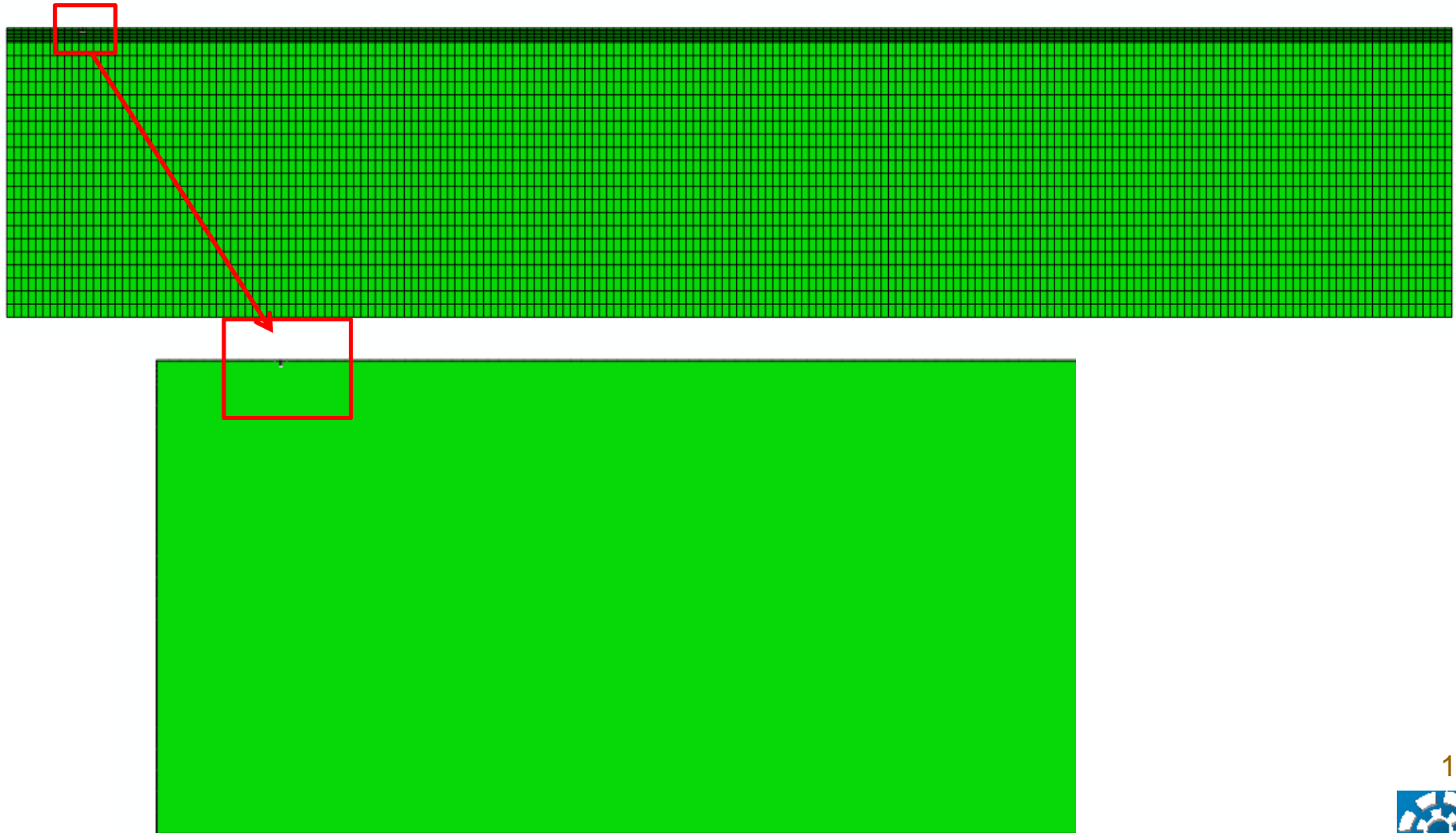
# Effect from Heat Source at crack

Cooling source → Contraction on surface

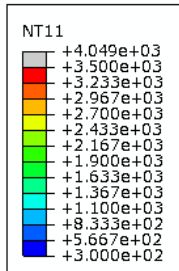
Use Abaqus + FORTRAN subroutine to simulate a moving cooling source (laser) on glass with initial crack



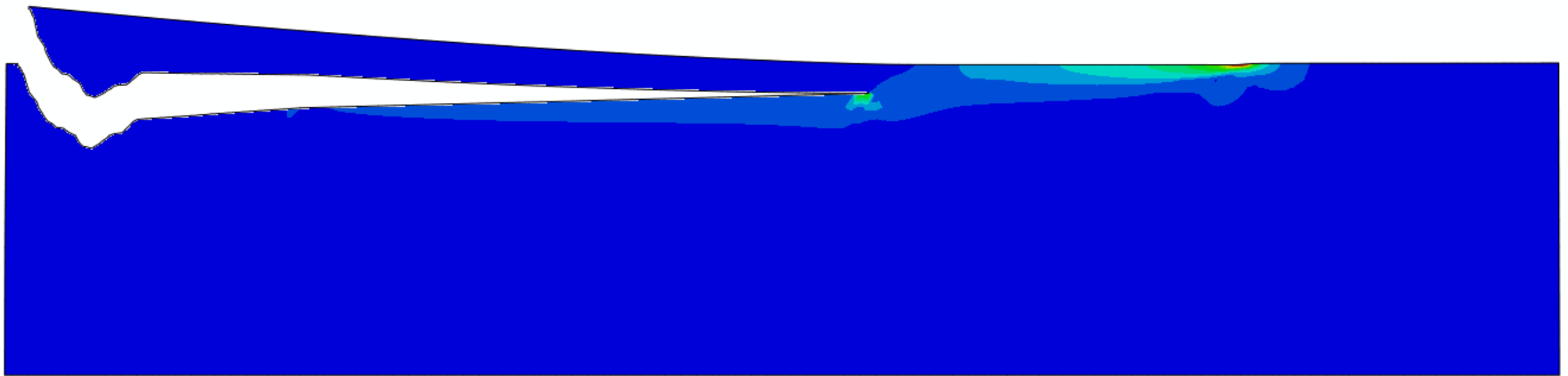
# Laser peeling model



# Laser peeling model



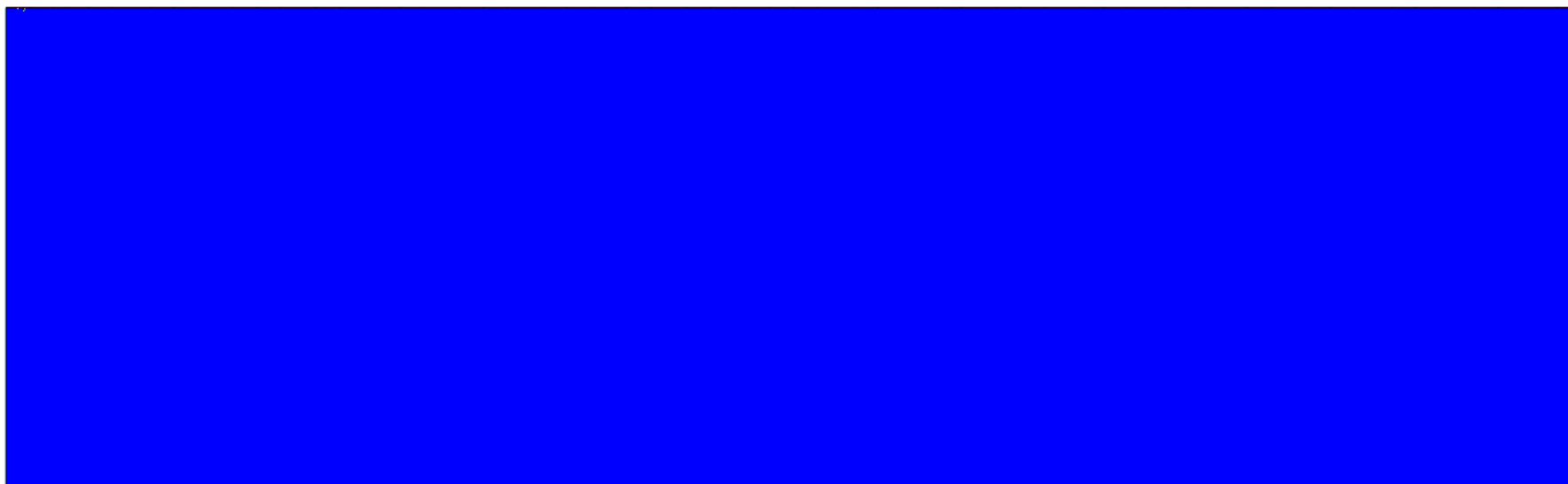
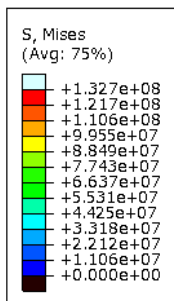
# Laser peeling model





# Laser peeling model

Step: Step-1 Frame: 0  
Total Time: 0.000000



# Future Work

- ◆ Basic studies of DCB benchmark
- ◆ UDCB
- ◆ Composite material analysis structure
- ◆ Laser peeling model





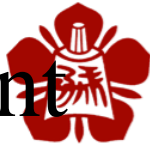
# 金屬與介電薄膜之熱機械性質 檢測與製程應用

參與研究人員： 黃致凱 (100), 蔡印耕 (102),  
楊子輝 (104), 莊喬棻 (106)

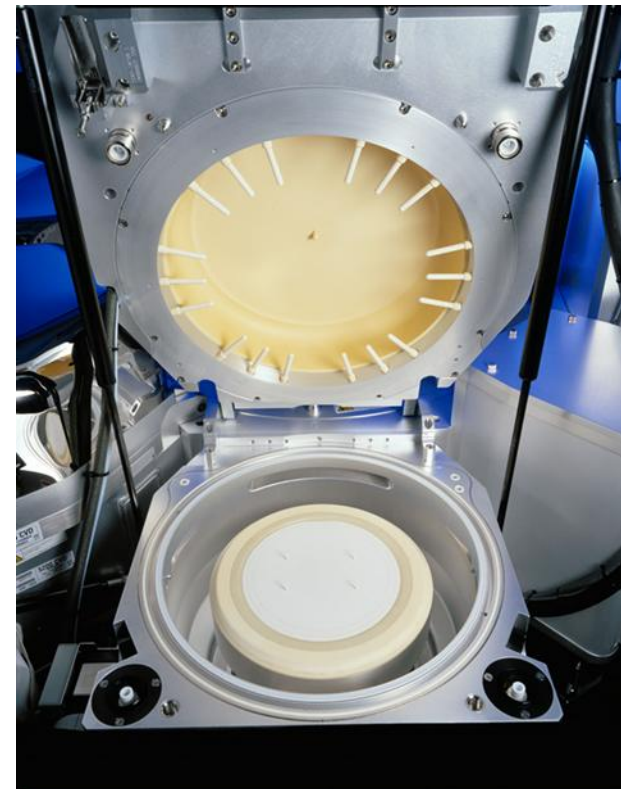
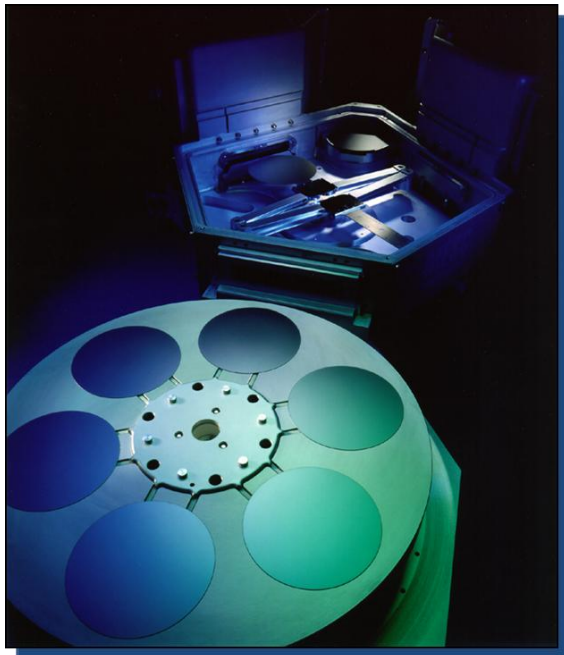
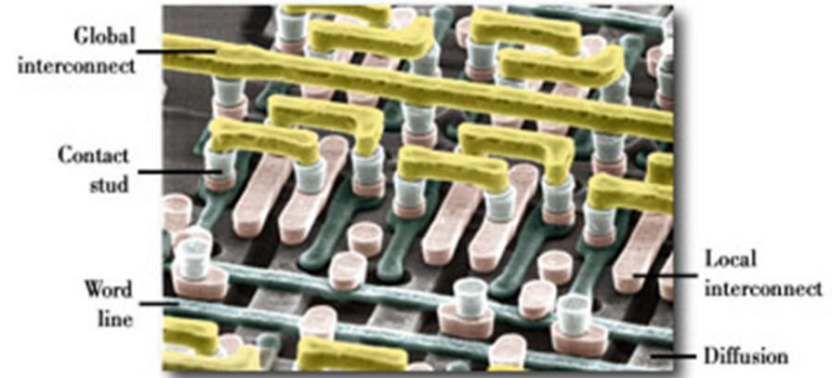
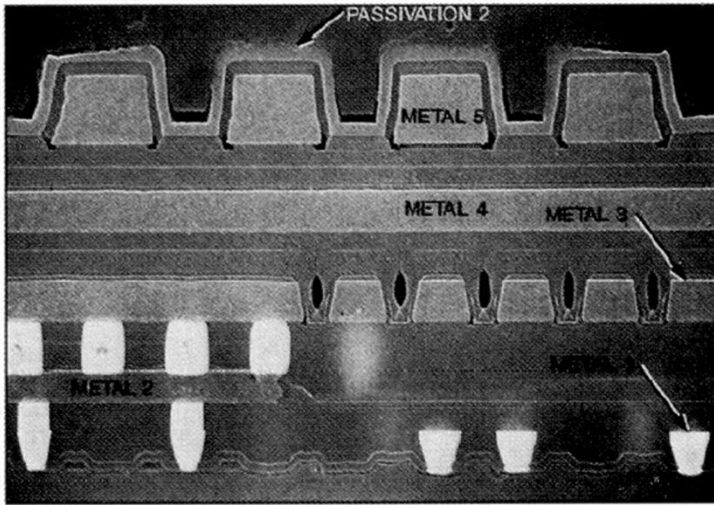
Principle Investigator: 陳國聲教授

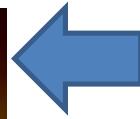
合作/討論教授： 屈子正 教授； 于劍平教授 (崑山)





# Thin Film Structures in IC Devices/Equipment

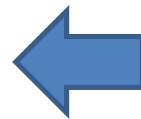
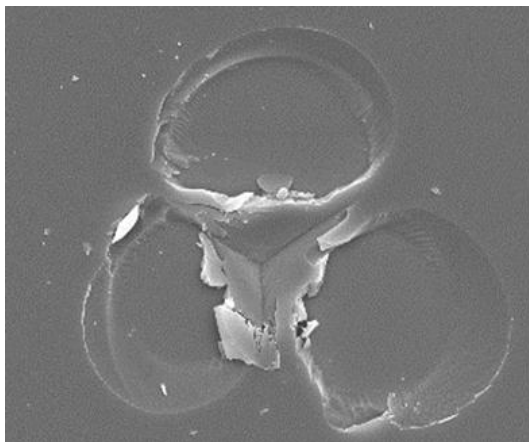
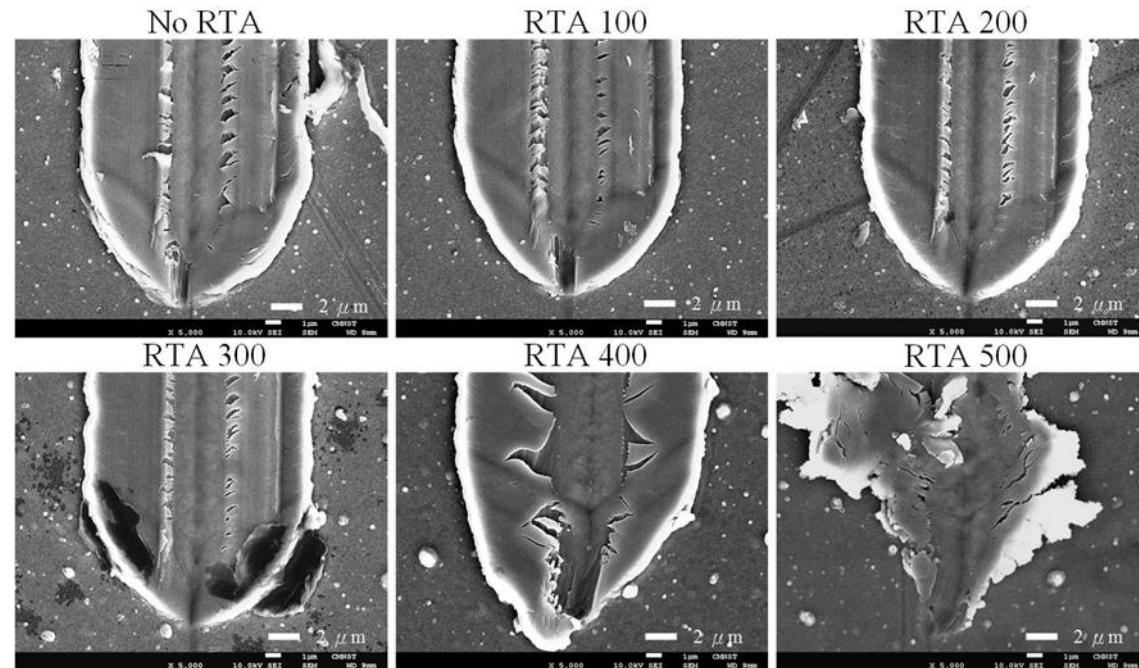




Rapid Thermal Annealing



Nanoscratch Test



Nanoindentation Delamination Test



# Existed and Possible Directions

- 薄膜熱機械性質與製程參數(e.g., 熱處理)之關係
- 薄膜殘留應力量測與分析
- 薄膜應力機制與微結構之關係/機制
- 奈/微米壓痕測試
- 接合強度測試與脫層模擬



# 橡膠軸承之力學與材料測試相關研究

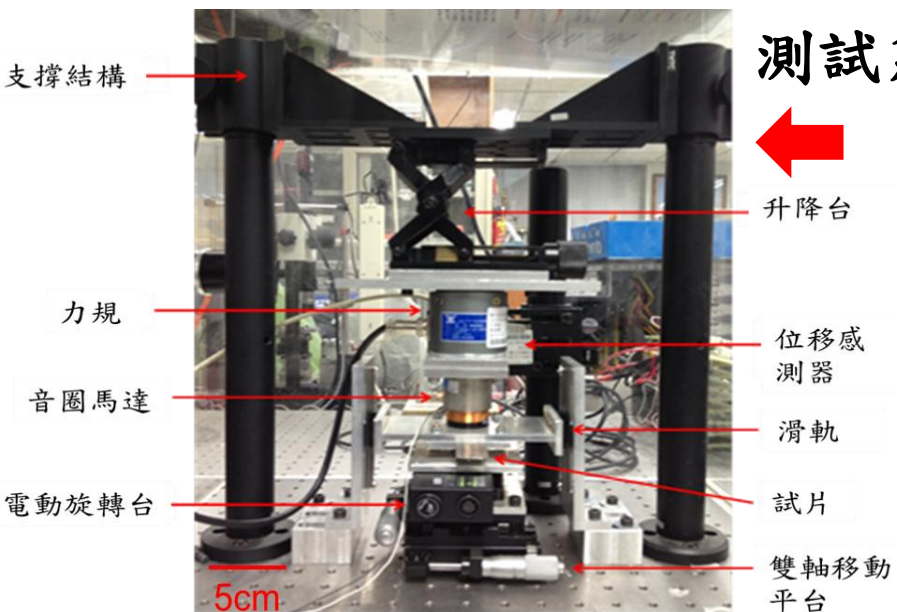
參與研究人員： 林佩君 (103), 洪榮燦 (105),  
鄭晏峰 (105)

Principle Investigator: 陳國聲教授

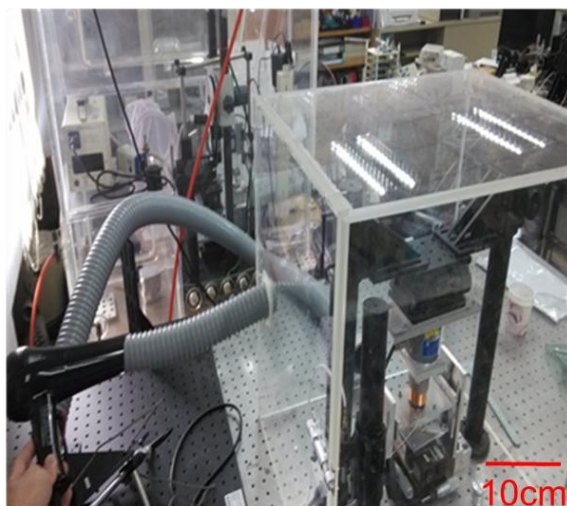
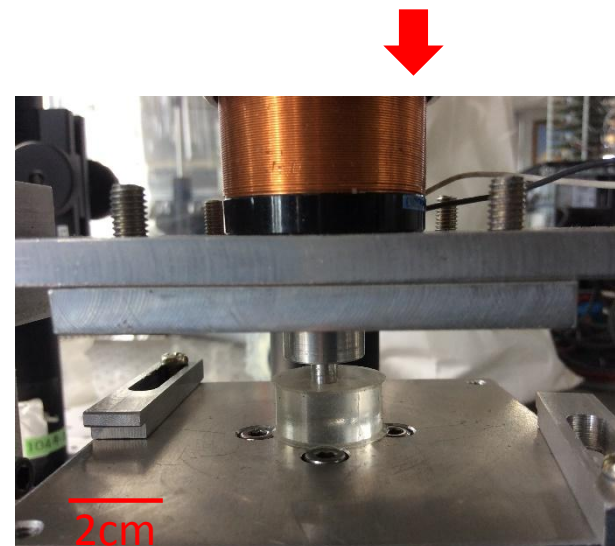
合作/討論教授: 屈子正 教授



# 雙軸式材料測試系統

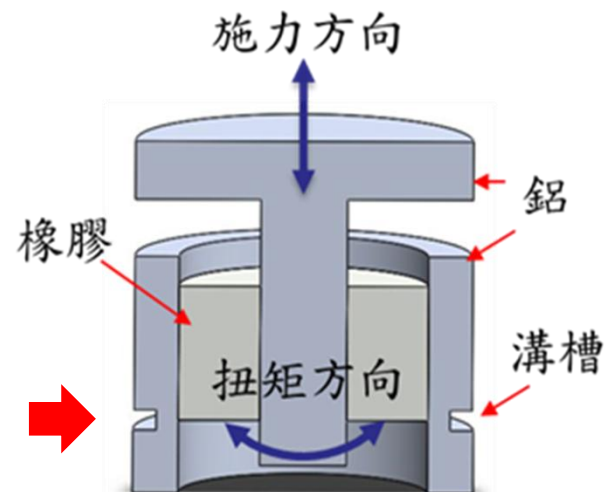


## 試片與壓縮測試



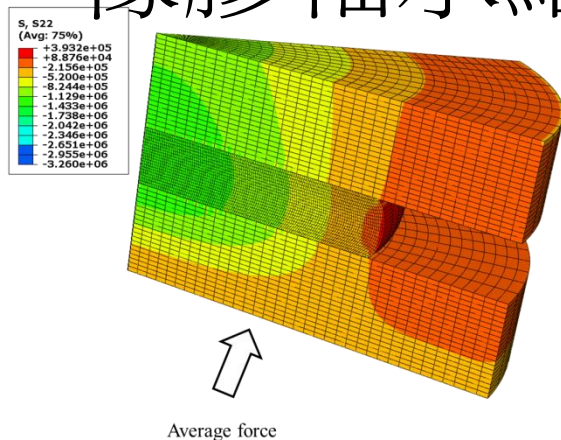
## 溫度循環控制

## 剪力夾具剖面圖

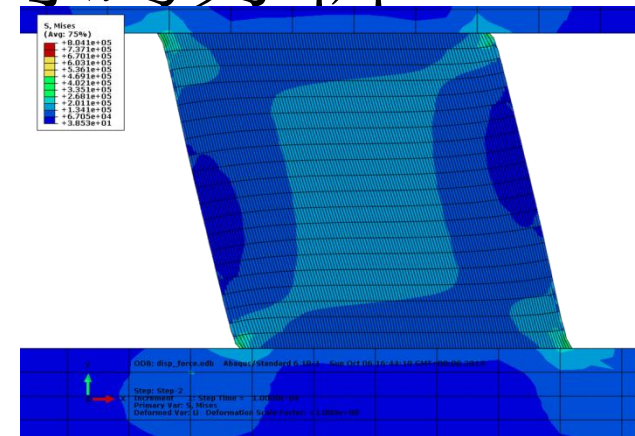




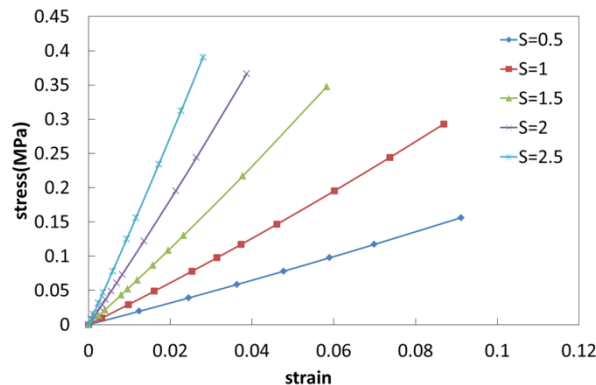
# 橡膠軸承結構力學行為分析



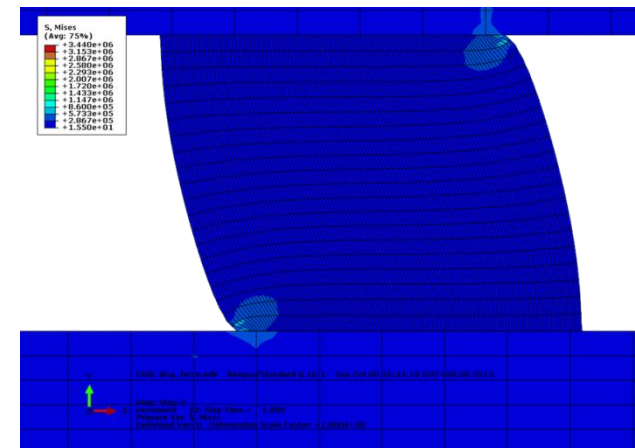
橡膠軸承模型受壓應力分布圖



橡膠軸承平移結果



不同形狀因子的應力模擬結果



橡膠軸承平移後受壓結果



# Existed and Possible Directions

- 橡膠軸承設計與測試
- 橡膠與金屬脫層測試
- 疲勞測試
- 雙軸動態測試





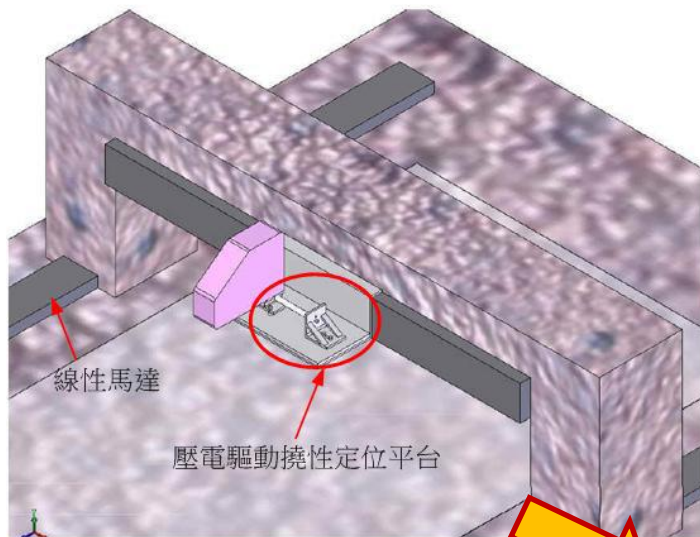
# 定位平台結合3D列印與橡膠之 設計與分析

參與研究人員：

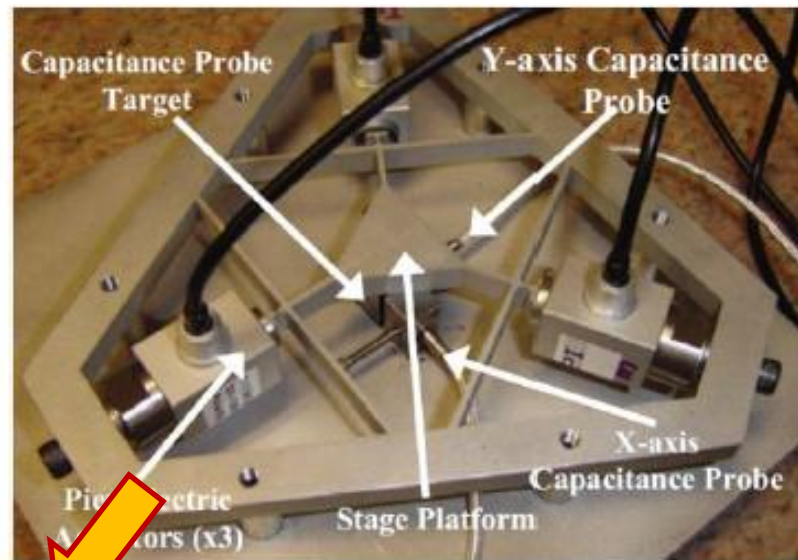
李哲維 (102), 鄧諺舉 (104),  
游逸萱 (105), 鄭晏峰 (105), 陳昱丞(106)

Principle Investigator: 陳國聲教授

合作/討論教授: 劉雲輝 教授; 黃偉欽 博士 (工研院)



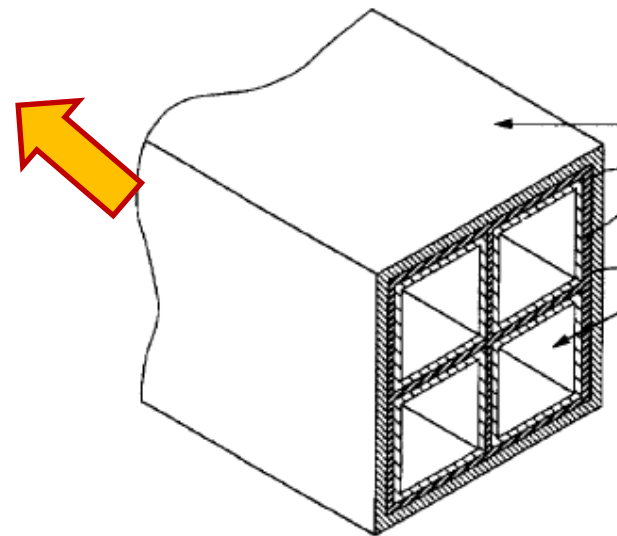
龙门线性马达



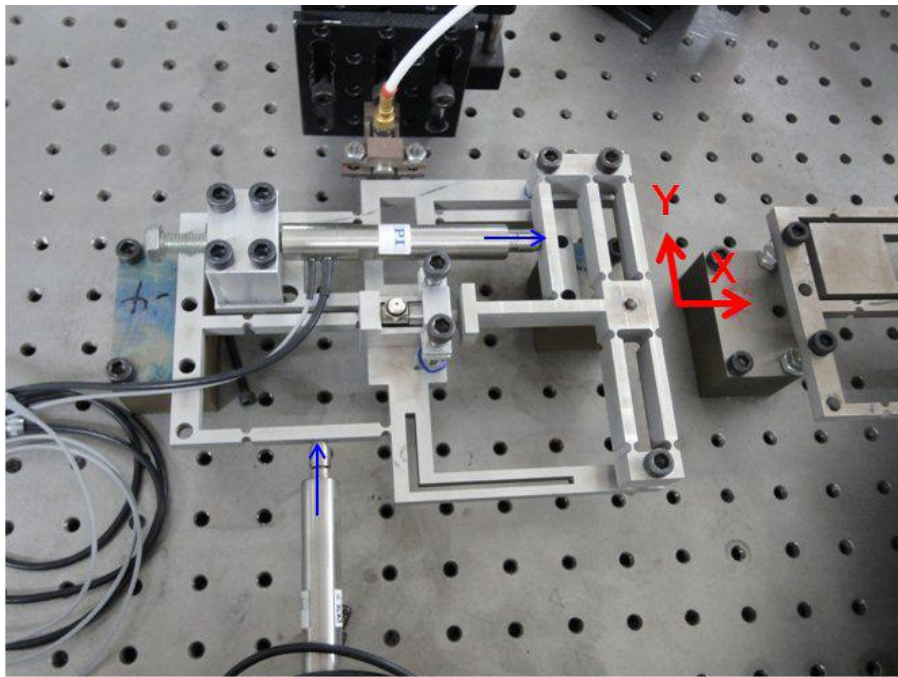
XY轴挠性机构定位平台



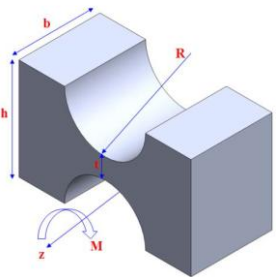
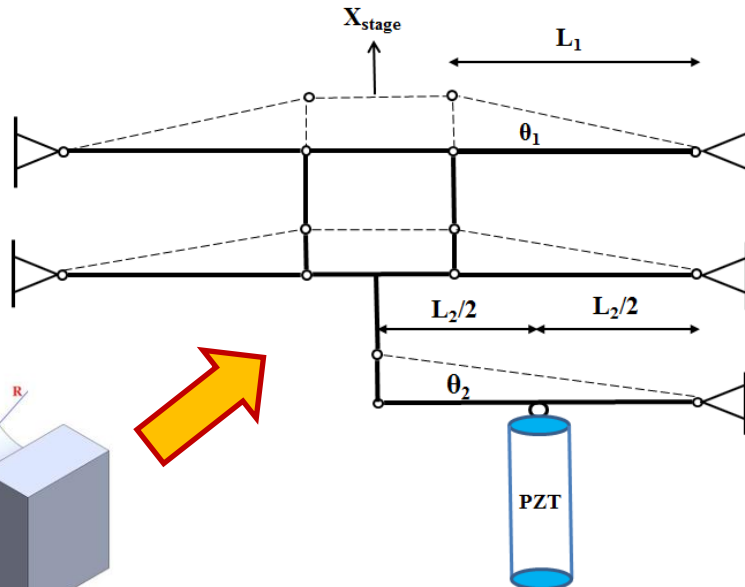
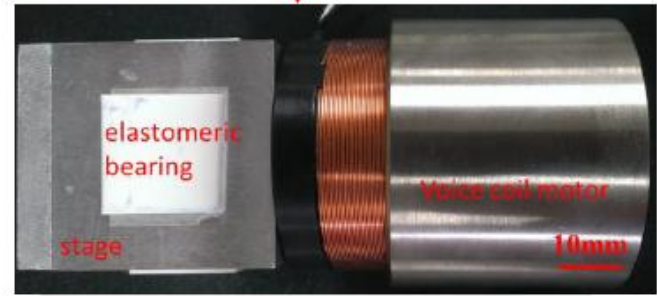
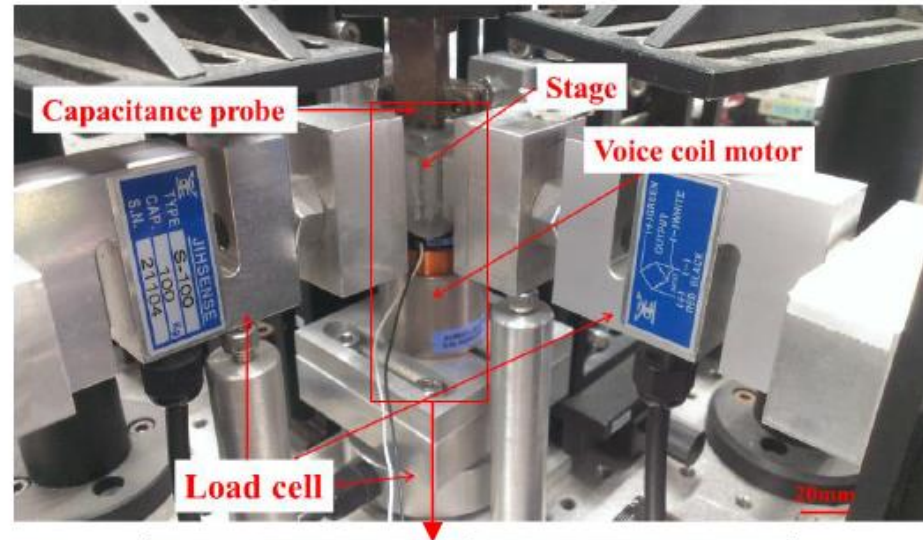
金属3D列印



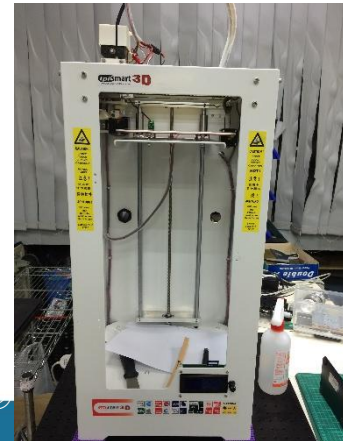
Shear damper



XY堆疊式平台 [李哲維]



橡膠軸承一維定位平台 [鄧彥舉]







# Existed and Possible Directions

- 雙軸撓性平台機構設計
- 搭配3D列印平台之致動器與感測器
- 3D列印平台之輕量化設計
- 3D列印與橡膠阻尼結合之相關技術
- 系統模型之參數量測



# 平台定位策略

## Analysis, Design and Control of Stage

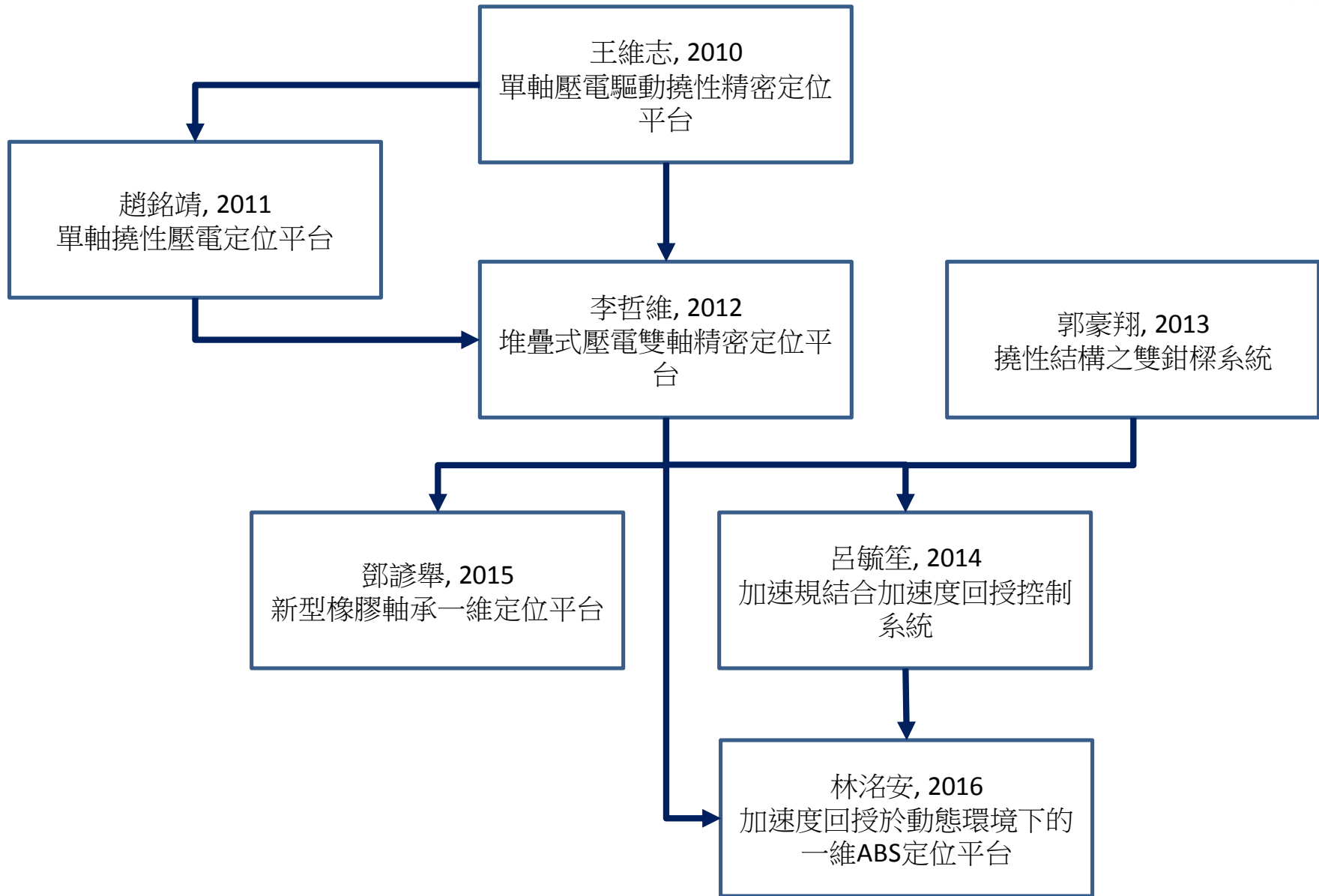
參與研究人員： 王維志 (99), 李哲維 (101),  
呂毓笙 (103), 鄧諺舉 (104),  
林洺安 (105), 李昱慶 (106)

Principle Investigator: 陳國聲教授

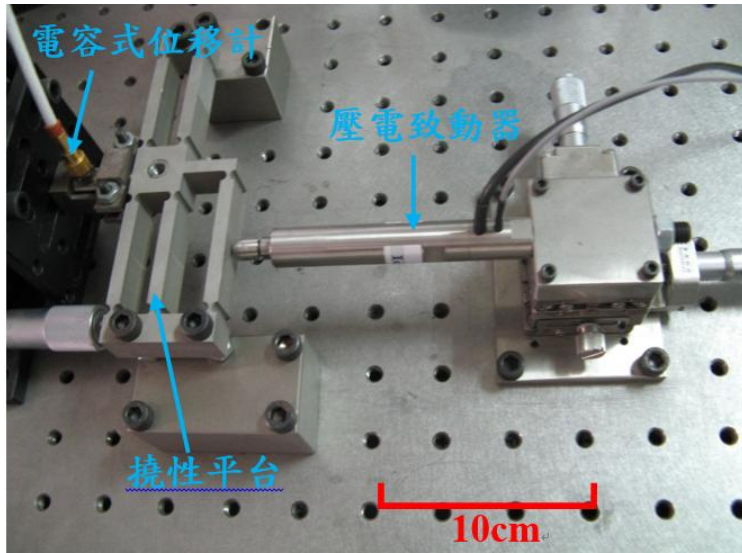
合作/討論教授: 劉雲輝 (南台科技大學)



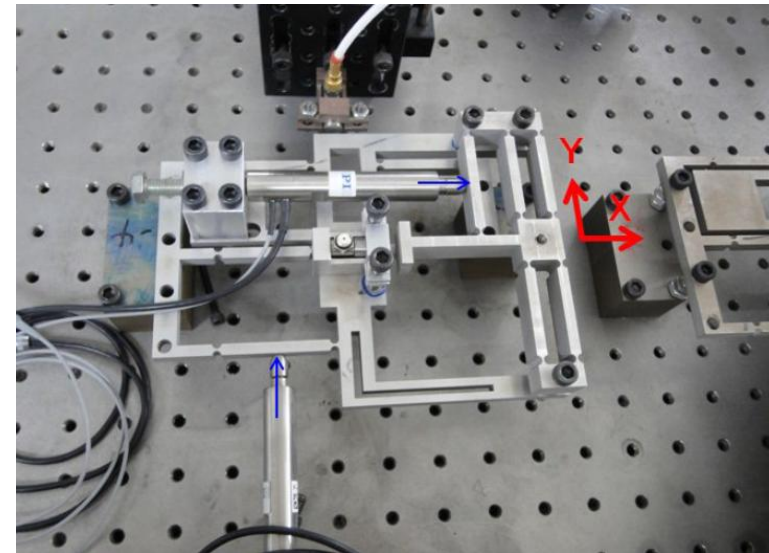
# Research Overview



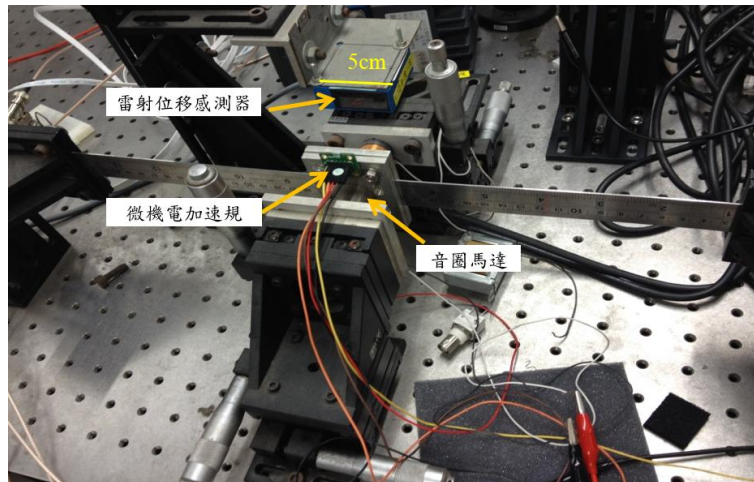
# Devices/Equipment



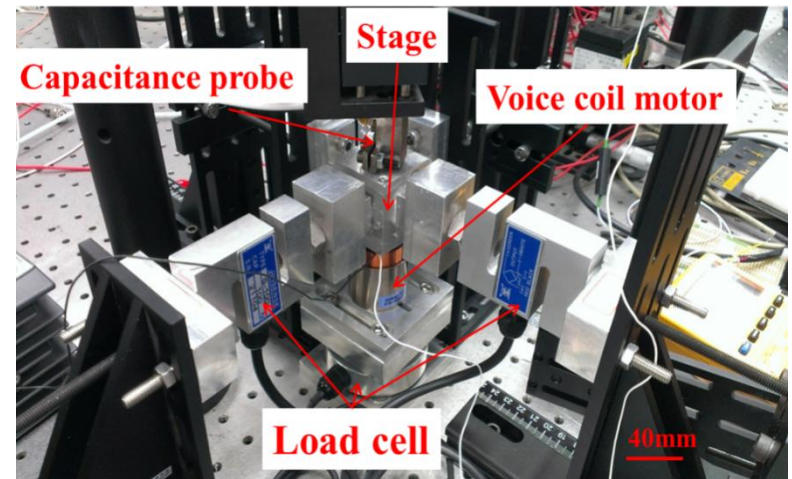
單軸壓電驅動撓性精密定位平台，王維志(99)



堆疊式壓電雙軸精密定位平台，李哲維(101)



加速度回授於撓性機構，呂毓笙(103)



新型橡膠軸承一維定位平台，鄧諺舉(104)





# Existed and Possible Directions

- 控制策略
  - 將加速度回授結合其他控制器設計方法(如設計高階非線性控制器、前饋控制)，以設計出較佳的控制器以提升系統定位能力與強健性。
- 平台設計
  - 考量阻尼係數下設計橡膠軸承
  - 多軸橡膠軸承定位平台之設計
  - 結合撓性機構和橡膠軸承設計新型定位平台之設計
- 結合
  - 應用精度較高的微機電加速規與加速度回授控制應用於雙軸精密定位平台上。
  - 將精密定位平台設置於線性馬達上，利用動態環境改善並設計出較合適的控制系統。
- 展望
  - 平台實際應用在精密機械機台上如自動化光學檢測機台或在精密加工部份



# 機器人相關研究

## 全向輪、飛行器

參與研究人員：

顧迪(100)、陳名薪(101)、王哲(103)、傅育德(102)

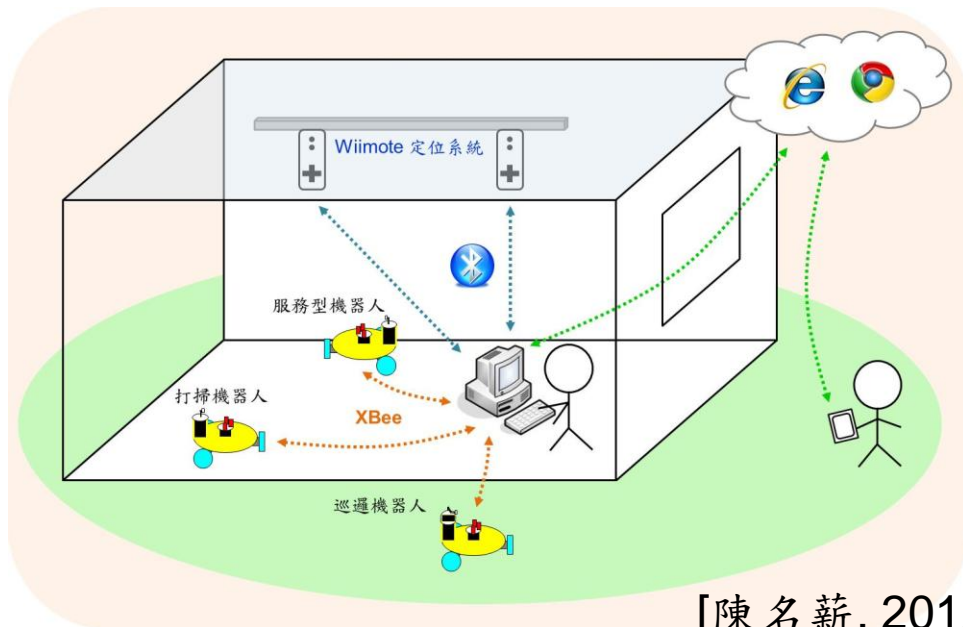
鄭中豪 (105)、詹惠媛 (大學106)、梁躍鐘 (大學106)

Principle Investigator: 陳國聲教授

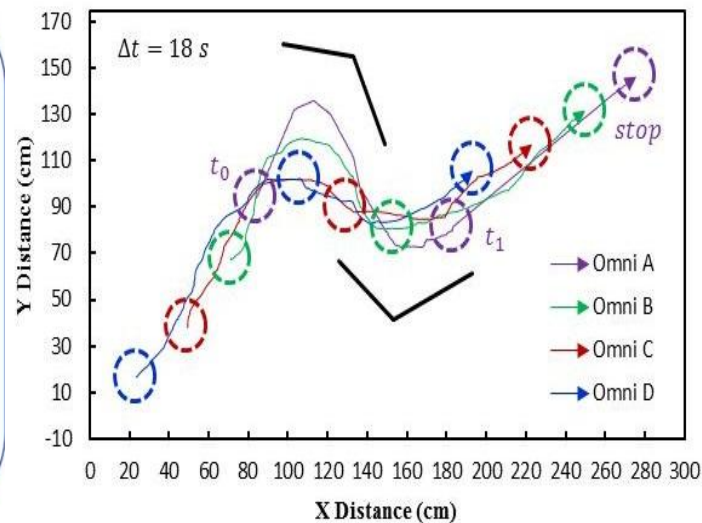
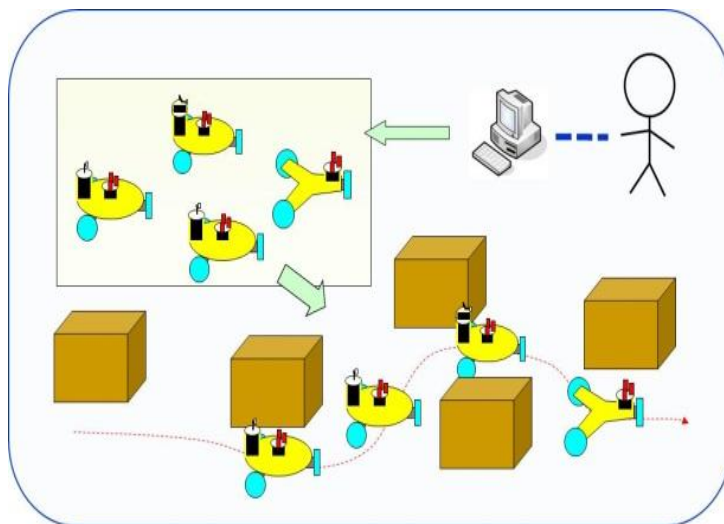
# 機器人相關研究



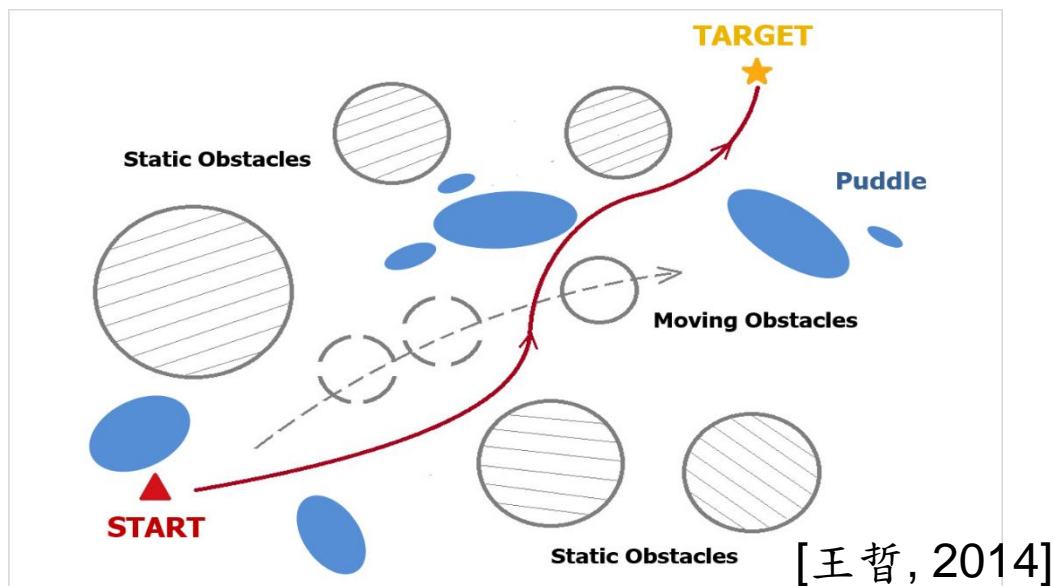
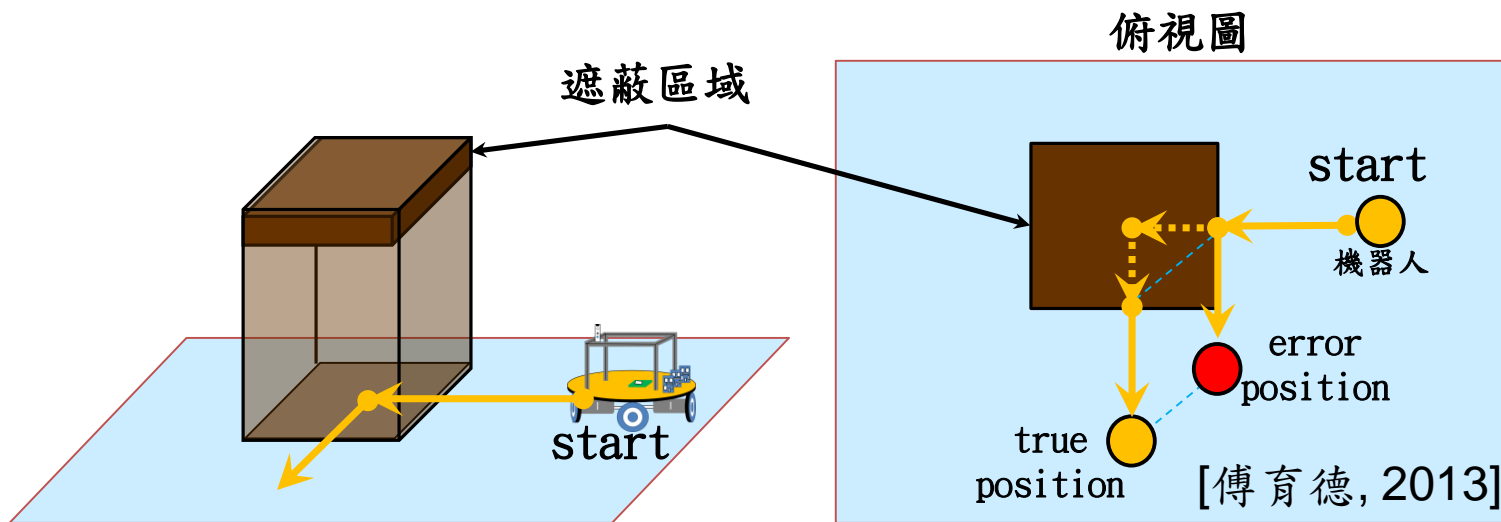
[顧迪, 2011]



[陳名薪, 2012]



# 機器人相關研究



[鄭中豪]

The robot starts at the starting point and its objective is to find an **obstacle-free, continuous path to the target**



# Existed and Possible Directions

- 全向輪機器人操控、避障、跟隨及導航
- 群組機器人之同步操控、避障、隊形變換
- 行進間經遮蔽物之路徑定位
- 機器人於室內智慧環境之路徑規劃
- 四軸飛行器用於室內定位應用



# 室內定位相關研究

## Wiimote、Smart Floor

### 參與研究人員：

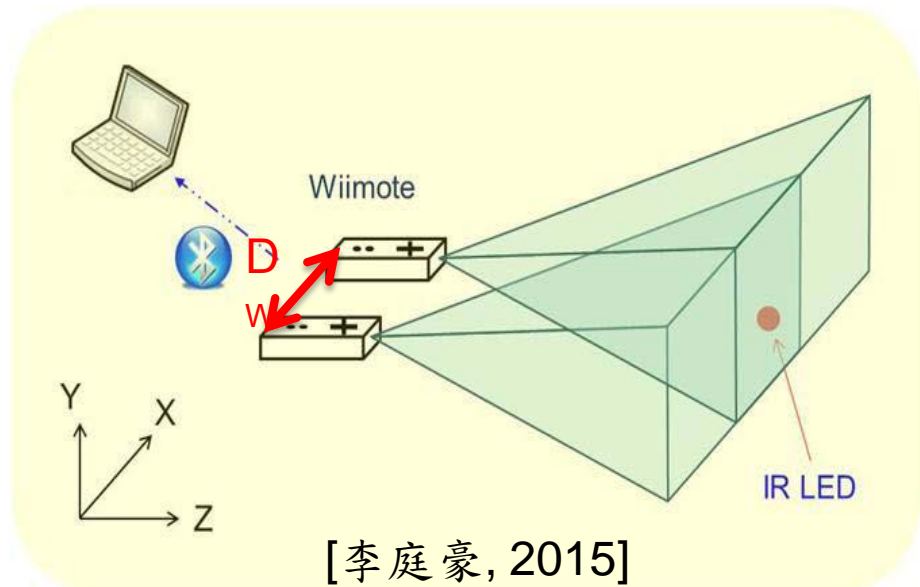
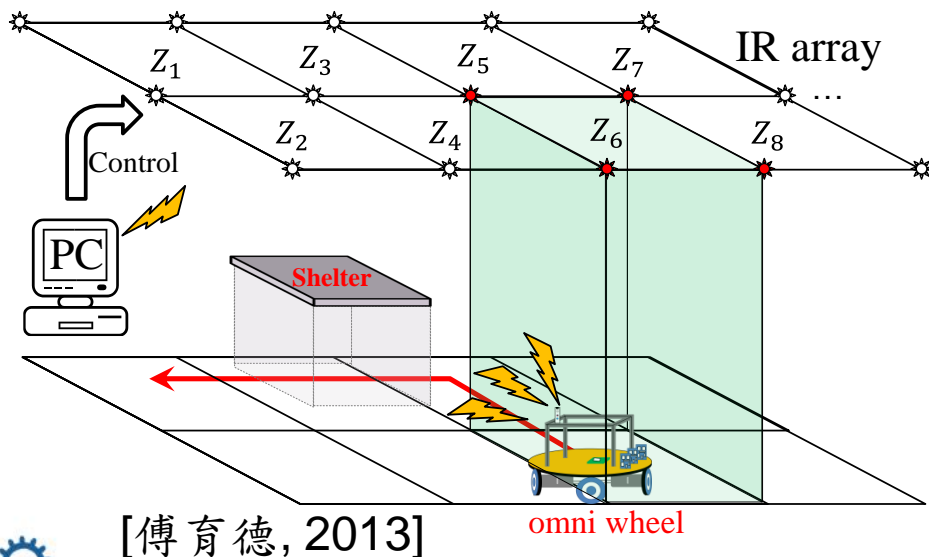
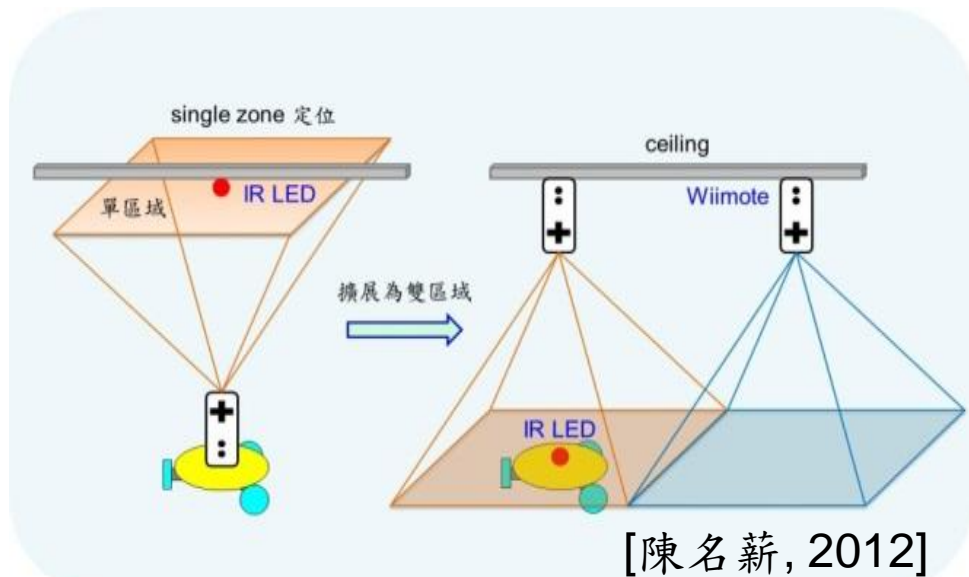
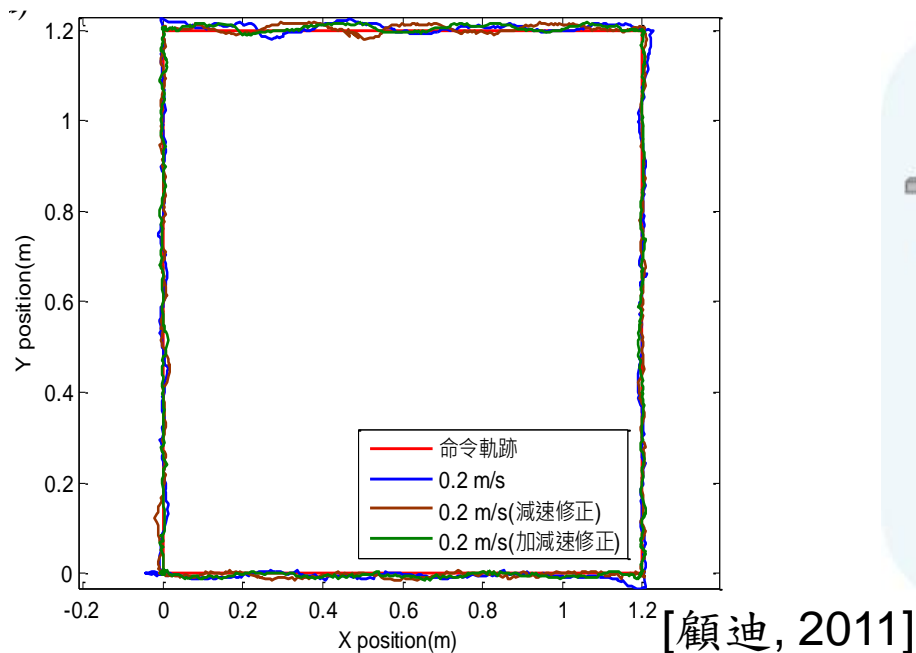
顧迪(100)、陳名薪(101)、吳名烽(101)

傅育德(102)、李庭豪(104)、鄭中豪(105)

Principle Investigator: 陳國聲教授



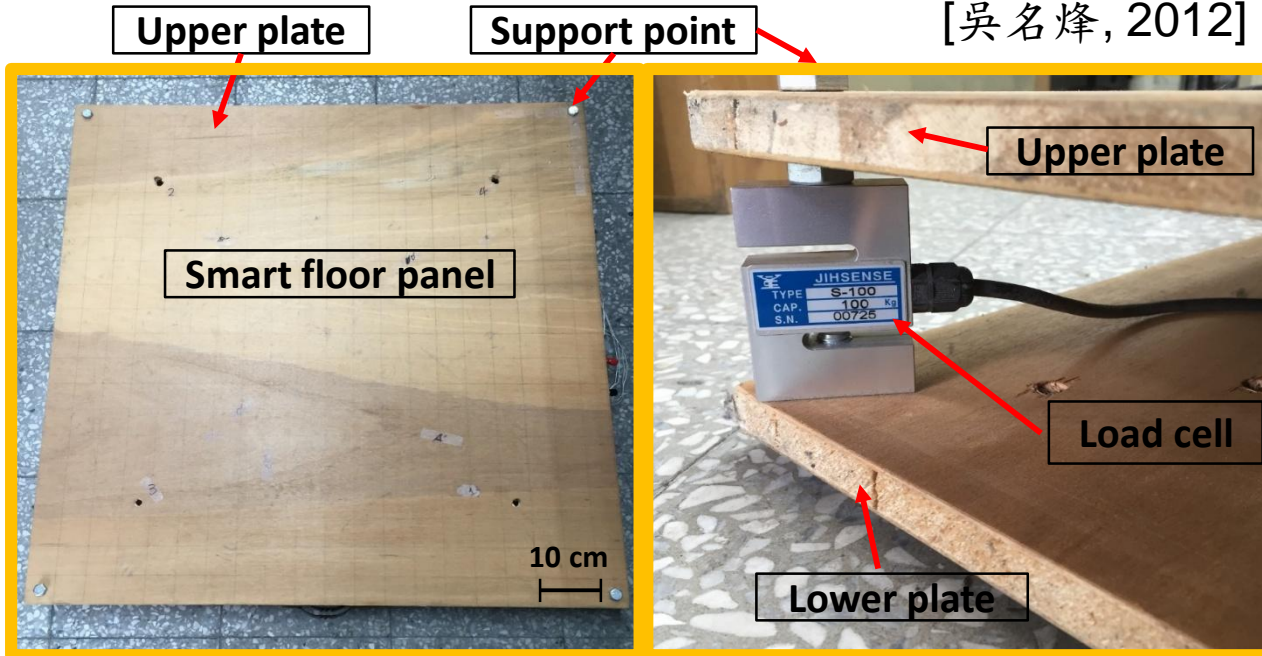
# Wiimote紅外線定位系統相關研究



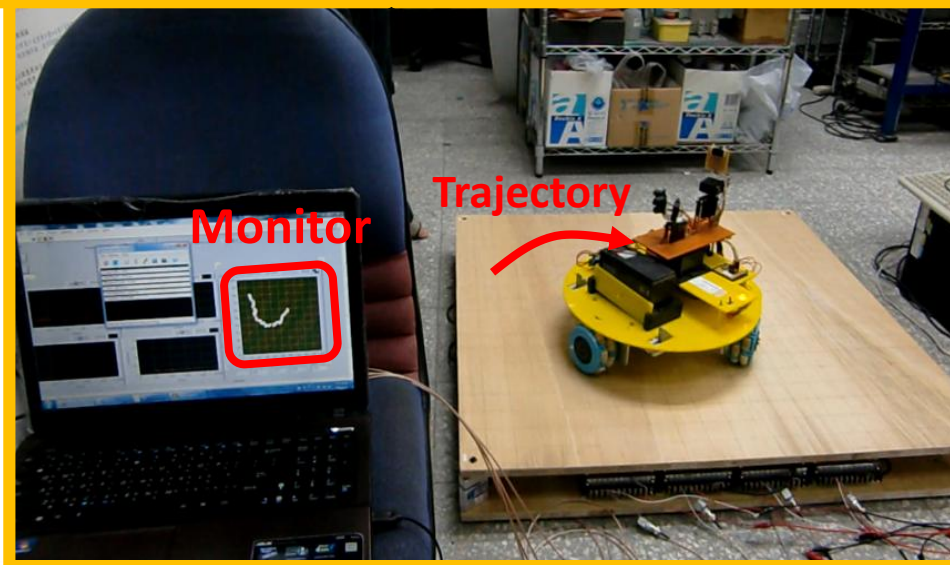
# Smart Floor 定位系統相關研究



[吳名烽, 2012]



重心量測



動態軌跡追蹤





# Existed and Possible Directions

- **Wiimote紅外線定位系統**
  - 2-D 室內定位
  - 3-D 室內定位
  - 可控式IR陣列定位系統、IR切換技術
- **Smart Floor 定位系統**
  - 單點定位、多點定位
  - 靜態定位、動態定位
  - 物體重心量測

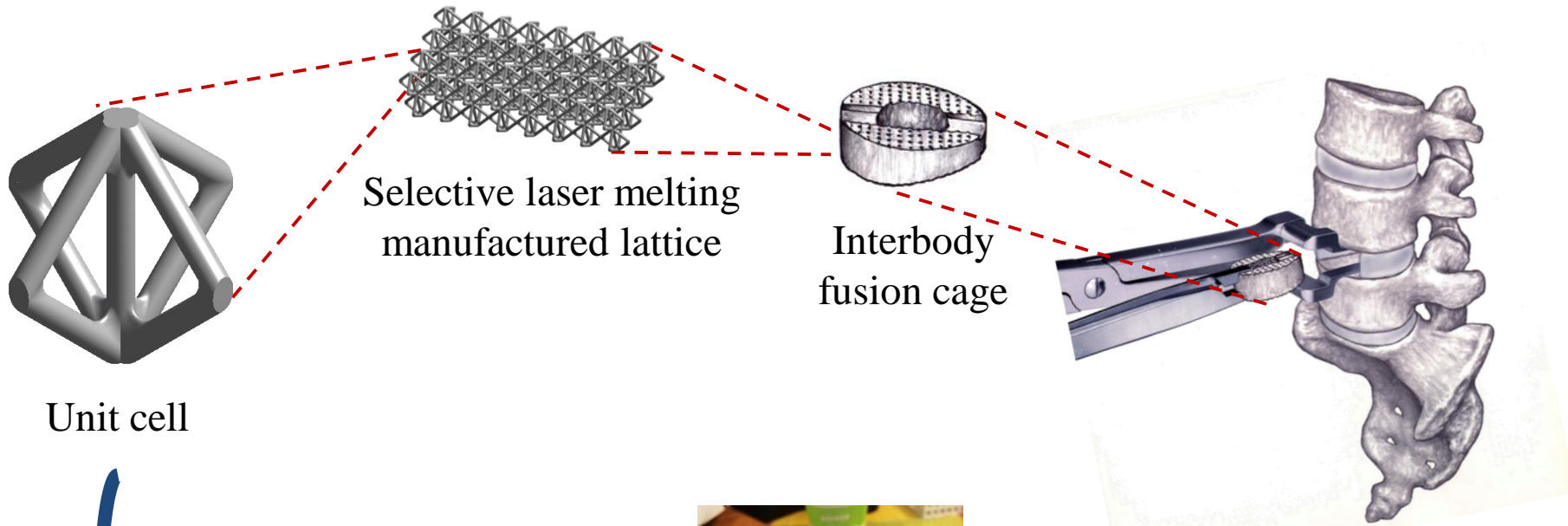


# 金屬3D列印週期性結構 ANSYS力學分析

參與研究人員： 洪榮燦 (105), 程心 (105)

Principle Investigator: 陳國聲教授

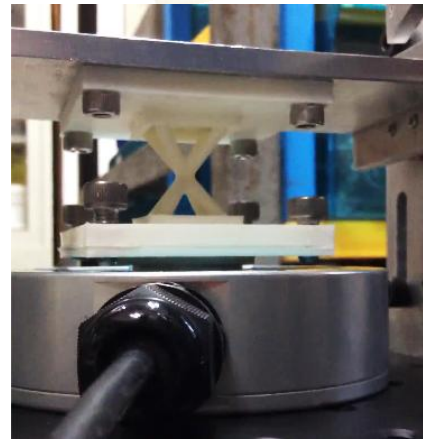
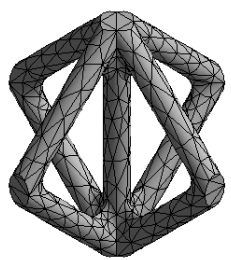
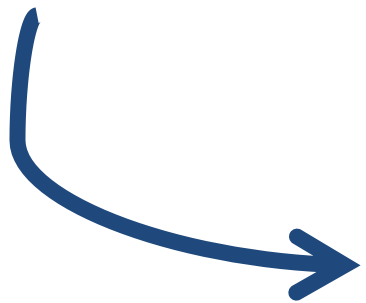
合作/討論教授： 屈子正 教授； 蔡宗汶 博士 (工研院)



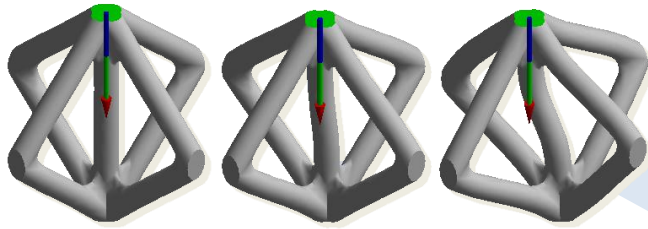
Unit cell

Selective laser melting  
manufactured lattice

Interbody  
fusion cage

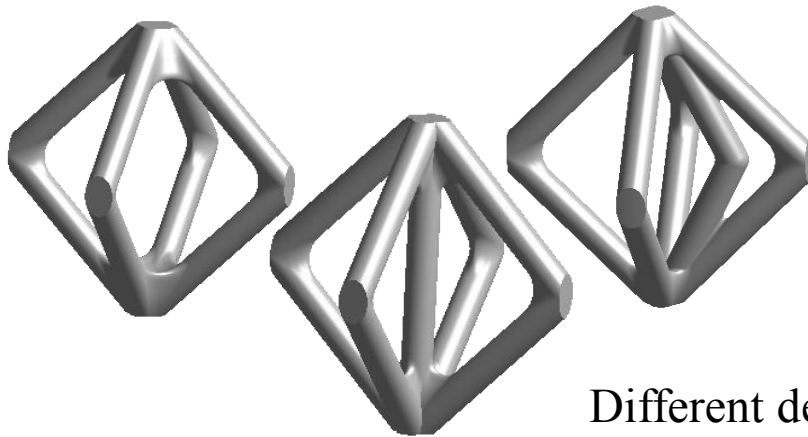
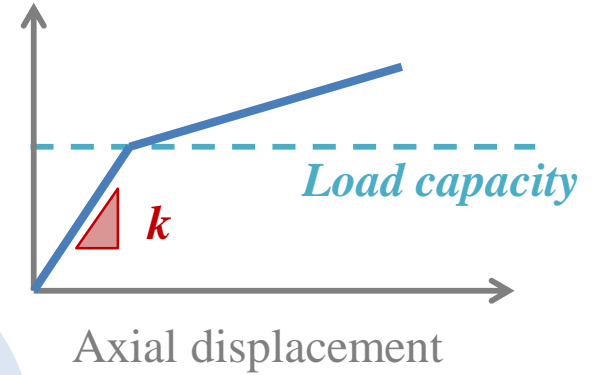


Finite element simulations  
and experiments



Axial compression via force/displacement control

Axial compression force



Different designs...





# 化學強化玻璃之雷射加工檢測

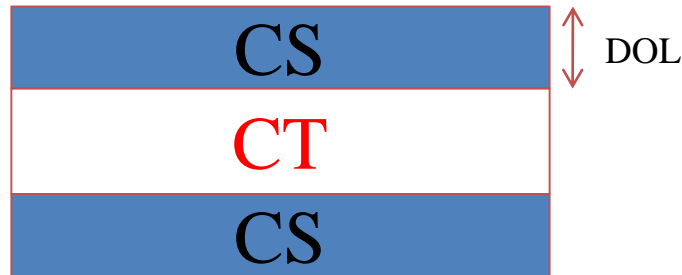
參與研究人員： 蔡印耕 (102), 楊子輝 (104),  
莊喬棻 (106)

Principle Investigator: 陳國聲教授

合作/討論教授： 屈子正 教授； 楊天祥教授  
林茂吉 工程師(工研院南分院積雷中心)



# Chemical strength glass in touch panel



- ◆ DOL : Depth of Layer
- ◆ CS : Compressive Stress
- ◆ CT : Center Tension



Samsung galaxy alpha

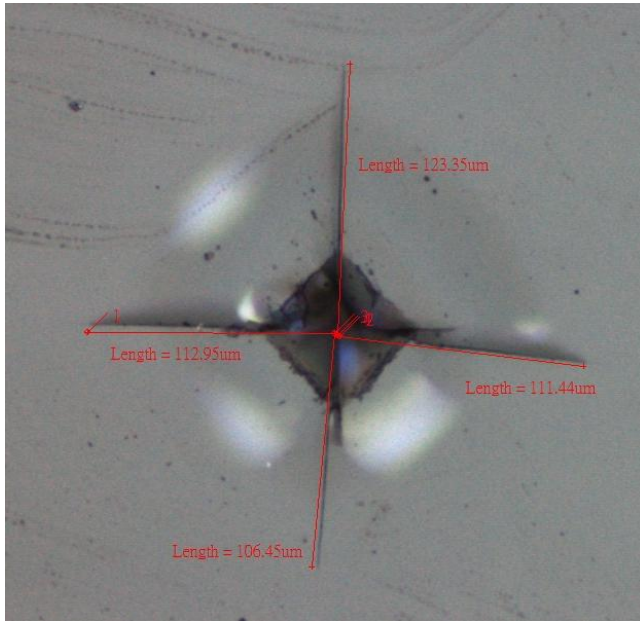


HTC ONE (M9)

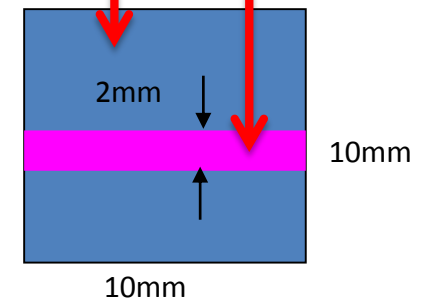
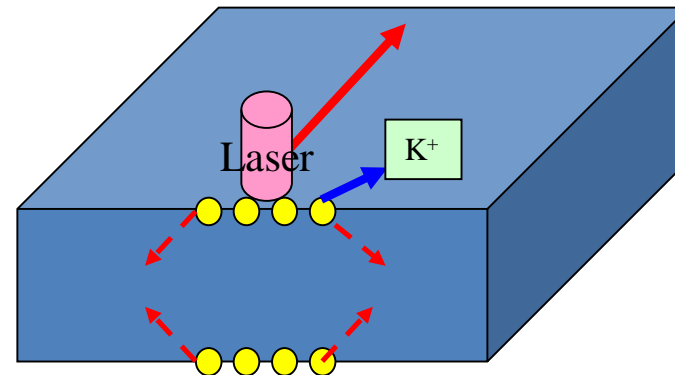
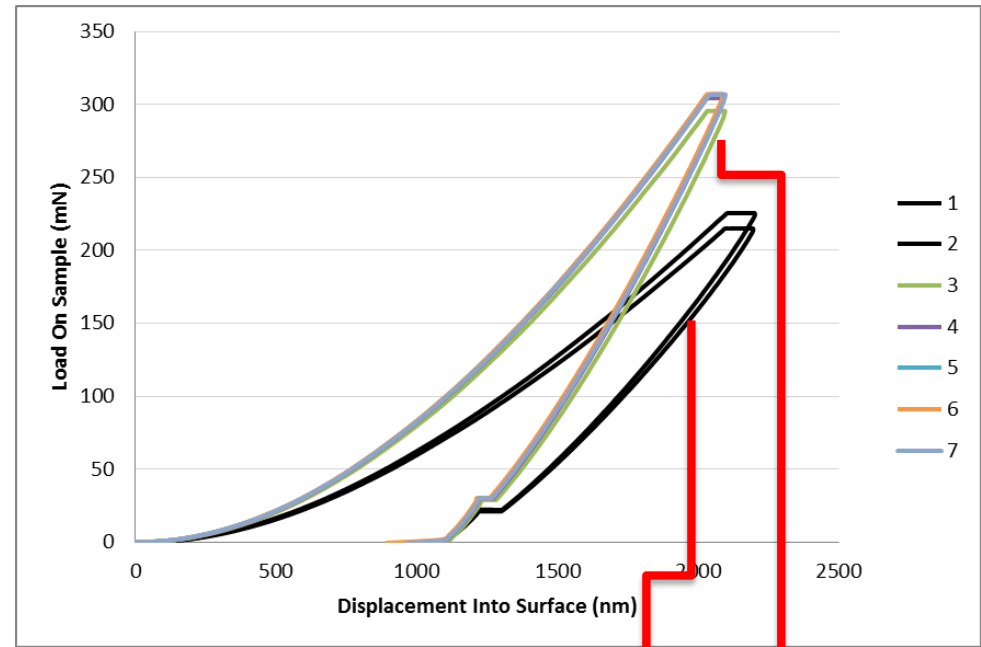




# Nano - indentation



## Micro - indentation



## CO2 Laser heating



# Existed and Possible Directions

- 化學強化玻璃在不同熱處理參數下之強度關係
- 化學強化玻璃經熱處理後，其本身改質與鉀離子擴散對強度之交互影響
- 化學強化玻璃於不同參數雷射光源作用後之機械性質量測
- 奈/微米壓痕測試



# 模態分析研究

參與研究人員： 鄧諺舉 (104), 陳璿文(大學104),  
陳昱丞 (106)

Principle Investigator: 陳國聲教授

合作/討論教授： 何旭彬 教授



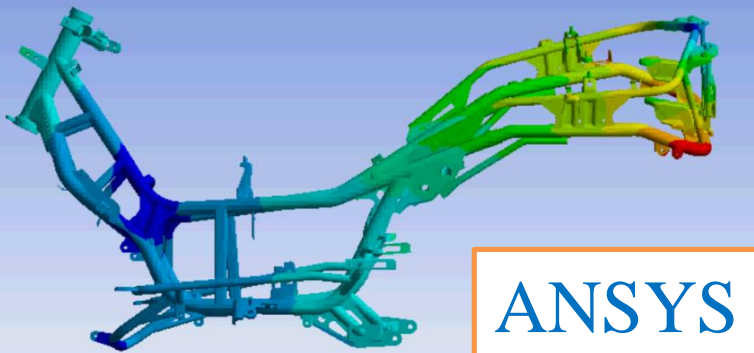
# Modal Testing

## Shaker Testing

車架



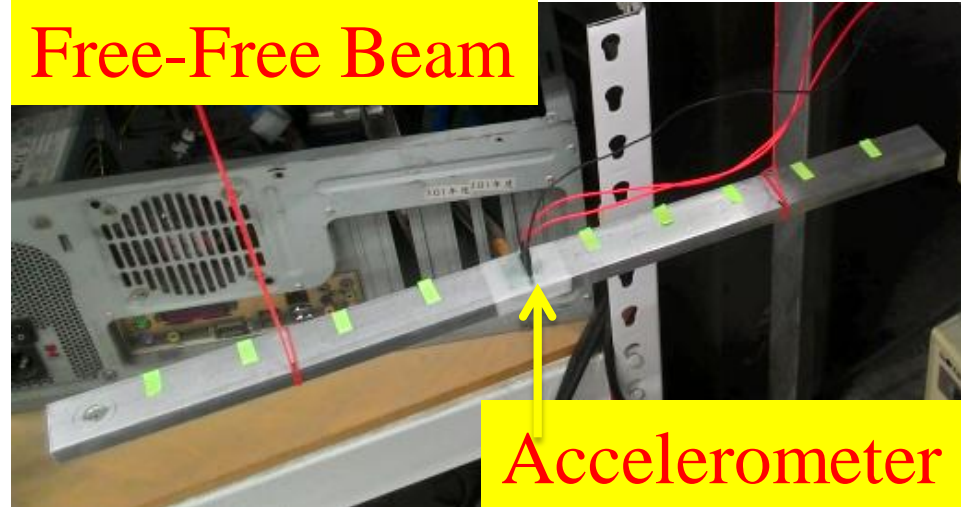
Shaker



ANSYS

## Impact Hammer Testing

Free-Free Beam



Accelerometer

STAR

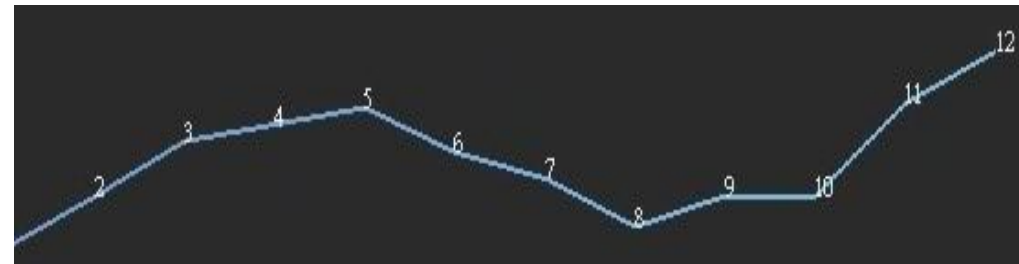




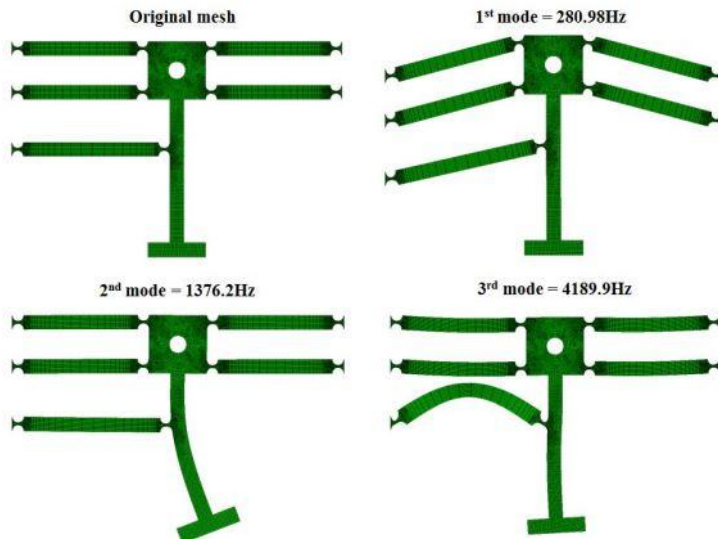
# Modal testing



# STAR analysis



# FEM analysis



Stage Design,  
Vibration Control





# Existed and Possible Directions

- 撓性定位平台模態測試
- 有限元素振動模態模擬
- 結合有限元素軟體、掃頻激振及頻譜分析軟體之模態分析
- 定位平台改善、振動控制



# 3C 裝置失效分析與 可靠度方面研究

參與研究人員： 莊昌鑫(103) 張宇凱(106)

Principle Investigator: 陳國聲教授

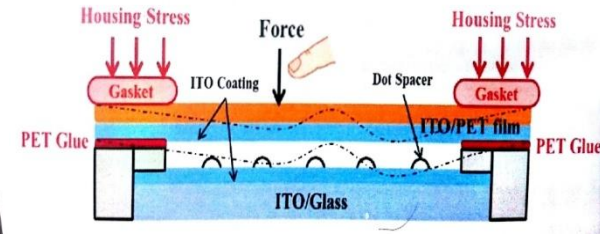
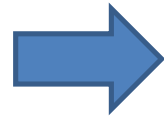
合作/討論教授：屈子正 教授 ; 陳俊志 博士(CISCO公司)



# Overview

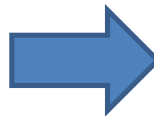
- 觸控面板觸控失效

挫曲與後挫曲分析於觸控面板結構功能失效之研究



- 面板漏光問題

面板在不同溫度和濕度下的失效分析

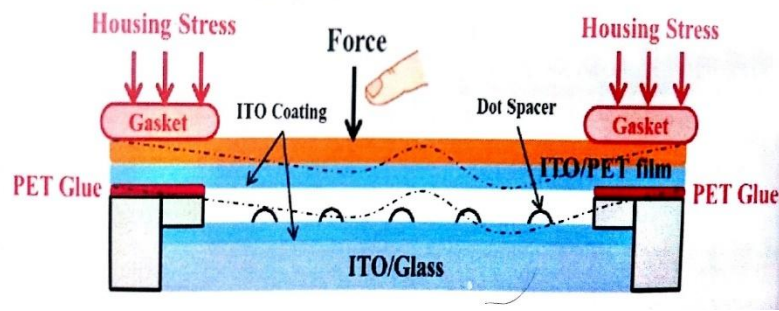




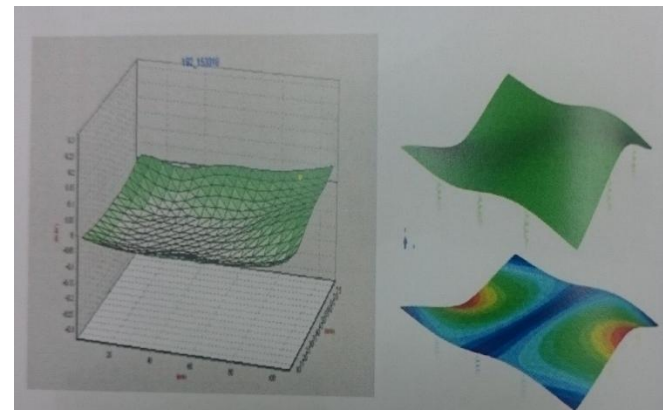
# 挫曲與後挫曲分析於觸控面板結構功能失效之研究



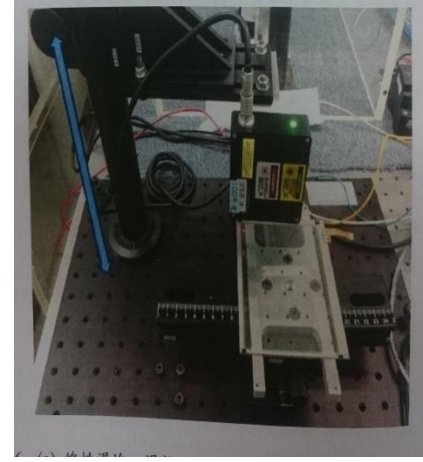
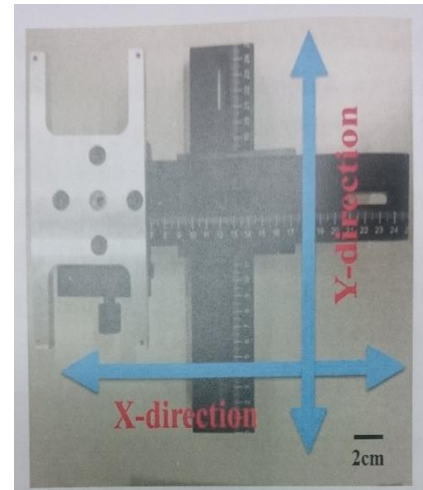
網路觸控電話



錯誤定位觸發



有限元素模擬



測試實驗



# 面板在不同溫度和濕度下的失效分析:第一部分



← 面板放入烘箱，**固定溫度和濕度**，進行**加速實驗**



← 加熱一段時間的面板，  
發生漏光現象



← 照片經**二值化**後，  
可得  
**漏光**部分面積(白色區域)

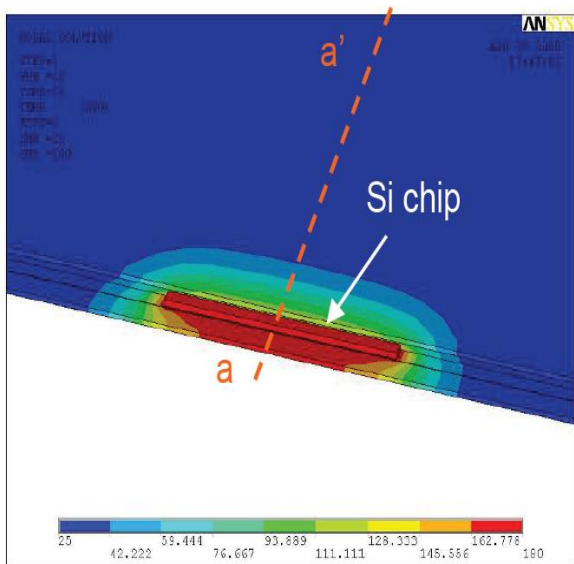




# 面板在不同溫度和濕度下的失效分析:第二部 分



← 雙軸向電動平台，用來量測面板表面的翹曲現象



← 對關鍵元素進行模擬