



AI對製造工程教育與研發的利與弊

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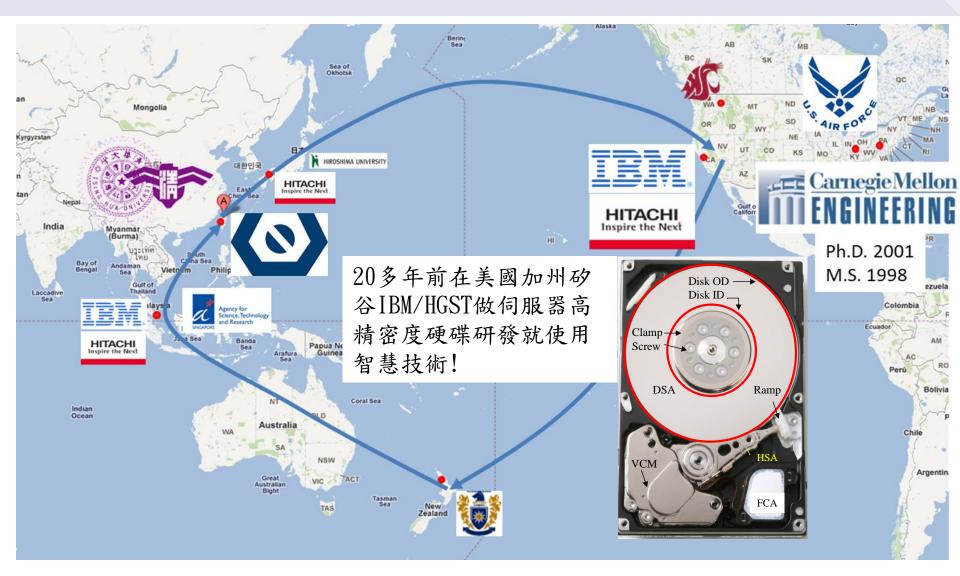
國虎尾科技大學 副校長暨講座教授

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I've Been Moved





AI 真是好工具!

- 突然間,我清華的碩博士生英語 寫作能力大增!
- 但是我相當擔憂! Why?

Re: soft robotics proposals

To James Chang

follow up. Start by Thursday, March 16, 2023. Due by Thursday, March 16, 2023.

Professor,

About the Soft robotics journal, I have used a program to recalculate the new figures this week and am currently writing with LaTex editor.

Thank you for the information, and I will refer to the attachment to adjust the content presentation of my journal.

Additionally, I have researched NTU's negative-pressure humanoid hand and have summarized its principle as follows:

Principle:

Utilizes negative pressure-triggered buckling to achieve joint movement.

Advantages:

Fast response time and wide range of motion.

Disadvantages:

- 1. Maximum output may be limited by the maximum force generated by buckling.
- 2. Joint angle control may not be precise due to the use of buckling for joint movement.







Speaking of 智慧 ...

Apple 1.0



Apple 3.0

Apple 4.0

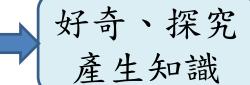








我知 故我在



數位化



智慧化



Photo source: 網路公開資訊

工業4.0-智慧製造

- Integration of manufacturers and suppliers to enhance collaboration across the value chain
- End-to-end digital integration of engineering covering the entire process from design to production.
- Cyber Physical System/Digital Twins with continuous improvement by feedback control, autonomous of integrated production.

數位化 自動化

智慧化



4. Industrial Revolution based on Cyber-Physical **Production Systems**

Industry 4.0



2. Industrial Revolution

through introduction of mass production based on the division of labour powerde by electrical energy

3. Industrial Revolution through Introduction of

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electronics and IT for a further automization of production

Industry 3.0

Degree of Complexity

Industry 2.0

Industry 1.0

mechanical production facilities powered by water and steam

End of

1. Industrial Revolution through introduction of

> Start of 20th

Start of 70ies

Source:網路公開資訊

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today

18th Century Century

NATIONAL FORMOSA UNIVERSITY

所以智慧化到底是什麼?是AI?

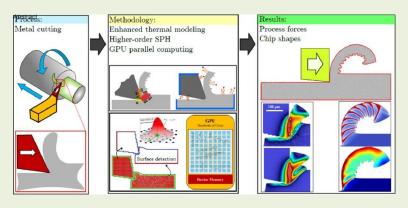


- AI 應該是串聯/整合(Integrate)智慧技術的工具。
- 數位轉型是其中必然的階段: 先數位化然後AI化。
- 任何X結合智慧技術都是智慧X!
- 除了智慧技術本身之外,紮實的製造工程知識(Domain Know-how)以及合適的Business Model才是關鍵!

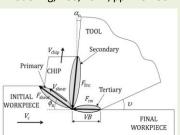


不管如何,都是在尋求解答!

Model-Based (Analytical + Numerical)



M. Afrasiabli, H. Klippel, M. Roethlin, L. Wegener, "An improved thermal model for SPH metal cutting simulations on GPU," Applied Mathematical Modelling, 100, 2021, pp 728-750.



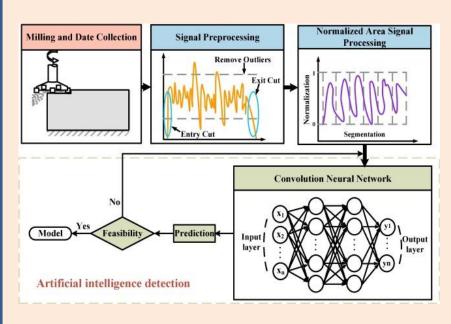
Cutting force

$$F_c = R\cos(\beta - \alpha) = \frac{wt_o \tau \cos(\beta - \alpha)}{\sin\phi\cos(\phi + \beta - \alpha)}$$

Friction coefficient

$$\mu = \tan \beta = \frac{F_t + F_c \tan \alpha}{F_c - F_t \tan \alpha}$$

Data-Driven

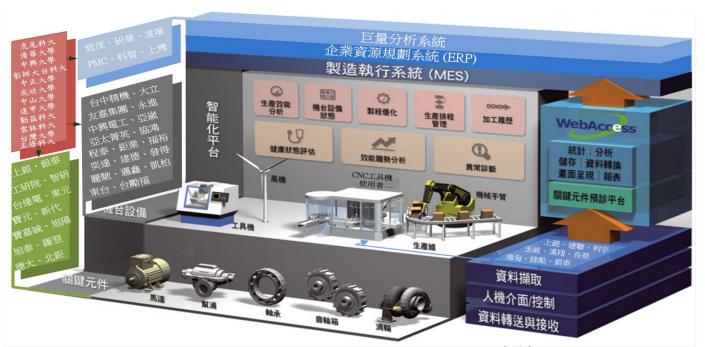


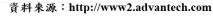
W. Xiao, J. Huang, B. Wang, H. Ji, "A systematic review of artificial intelligence in the detection of cutting tool breakage in machining operations," Measurement, 190, 2022, 110748.



AI化對製造工程教育與研發的好處

- 數位化讓經驗變成數據, AI 化使得製造可以 versatile for various demands。
- 打破專業之間的藩籬 「黑手」VS 所謂「高科技」。
- 可以整合跨領域的專業知識,或許也能產生新的知識或是改進現有的知識,但是要看使用者的思維。







AI化對製造工程教育與研發帶來的缺點

- 教育與研發的宗旨:
 - > Generation of new knowledge.
 - ➤ Improvement of existing knowledge.
 - ➤ Value up + cost down!
- · 若不善用AI則會
 - ▶ 弱化基礎工程教育。
 - > 忽略工程訓練與思維。
 - ▶ 沒有團隊合作→在數字與螢幕後。
 - ➤ 一切都是理所當然→會用工具 但對應用對象相關的科學與技 術知識不甚了 vs Explainable AI、Trustable AI。





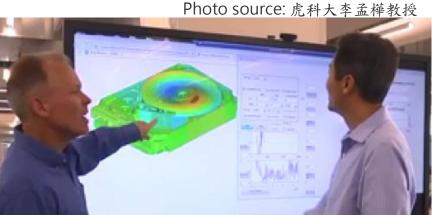
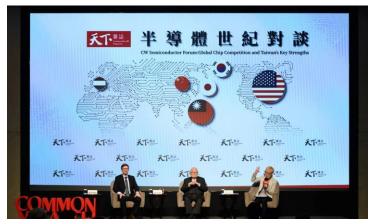


Photo source: 本人在IBM/HGST/WD的同事 Prof. Jen-Yuan (James) Chang

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工程教育與研發應考慮「競爭優勢」

- 美國:強在Design、Innovation、 Leadership & Collaboration.
- 台灣:
 - ▶ 過去在Science, Technology,Engineering, and Mathematics 的基礎教育相當紮實。
 - > 文化與態度。



張忠謀提到台、美工程師的不同工作態度,「若半夜1點設備故障, 在美國,隔天早上8點才有人修理。在台灣,半夜2點就修好,因 為工程技術人員即使在睡覺,接到電話就會穿衣服出門,妻子問 他要去哪,他說要到公司修理設備,妻子就回去繼續睡覺了;而 美國工程師會繼續睡覺。」



From Garage to the World - 台灣能嗎?

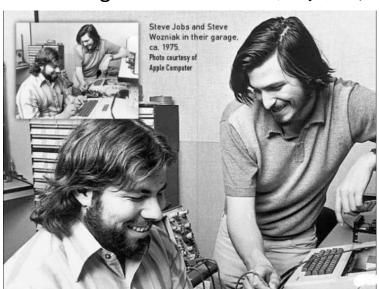




Photo source: 網路公開資訊

工程教育與研發應要「誠正精勤」

工程教育與研發:

工程 = 科學 + 經濟 Engineering = Science + Economy

(ME, ChE, IE, MSE, CE, EE,...)



- ▶ 精度、速度、温度、亮度、強度之謂也!
- ▶ 現在的大師造就未來的大師 不僅傳授「知識」,更是傳授「學問」!
- ▶ 紮實的STEM基礎教育,訓練未來的大 師產生新知識、改進現有的知識!
- ▶ 學問可以將知識變成智慧,將<u>需求</u>轉化 成價值 → Value up + cost down!

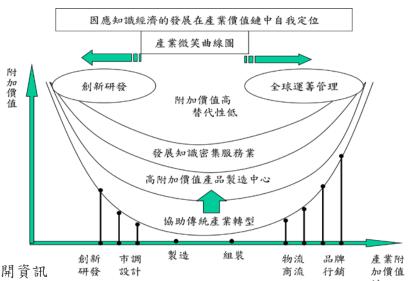


Photo source: 網路公開資訊



工程教育與研發應要「厚德載物」

- 獨奏 VS 合奏 工程師是要團隊合 作,沒有誰是比較厲害、比較高尚!
- 跨領域 專業間的尊重與合作。
- 高科技 VS 傳統產業 只要是能夠 將價值產生和提升就是「高」科技!



2. 創意設計、 工程 計算(不足部分需主 動找資料)





3. 實作與團隊合作



1. 討論、腦力激盪、 辯論



4. 發現問題與解決



本人教授清大工學院跨領域專案計畫以及 工程導論學生之成果

跨領域整合 Interdisciplinary 辯証法思維 Dialectics 主動探索 Enquiry 多元真實性學習 Authenticity

Capstone Course

材料四



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工程教育與研發應要「自強不息」

- Why? <u>過去</u>的成就並不代表<u>現在</u>和<u>未來</u>的成就。這世代是全球競爭 的世代!
- 應摒除二分法的思維-高教 vs 技職,高科技 vs 傳統產業,etc.
- 三個ion: Vision, Passion, Action
- 三個C層次: Can Do, Can Win, Can Lead

Courtesy of 蘇評揮 教授

Scenario Base; C2C (Concept to Customer) 3個ion! Items ①智慧(創新)->財產(出海口) Vision Level I. ②產學研平台(Advanced Technology Platform) & CAN DO 基礎/先進技術專精實驗室(Core Lab.) **Passion** Level Π . **CAN WIN** 3 Project Management & Meeting KPI Action (40% Gross Margin) Industry Applications (Time to market impacts) LevelⅢ. **CAN LEAD 5** Global Promotion



AI智慧製造與數位轉型引領智慧經濟

善用AI,透過扎實到位的工程教育與研發來產生全新以及具進步性的專業知識,並搭配合適的商業模式將價值提昇,大家一起共同以智慧造價!

過去與現在: Work Hard



Photo source: 網路公開資訊





I've Been Moved by Taiwan!







Thank you for your attention!

