

中英文科技論文寫作要領¹

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摘要(Abstract)

科技論文，不管是以中文或英文撰寫，都是由六大結構所組成(依出現順序):(1)摘要-將整篇論文濃縮成一個小段落，(2)導論-論文在相關文獻中的定位，(3)方法-介紹研究工具，(4)結果:以圖形表格呈現研究成果，(5)討論:看圖說故事，(6)結論:希望讀者永遠記得的幾句話。本文將介紹這六大結構的內容及其寫作要領。介紹的順序是依照六大結構在論文中的排列順序，但要注意的是一篇科技論文的實際寫作順序與其論文結構的排列順序不同: (3)方法→(4)結果→(5)討論→(6)結論→(2)導論→(1)摘要。其中的摘要排在論文的最前面，但是在寫作過程中是最後才寫的，這是因為摘要是濃縮版的論文，要等論文內容全部確定後，才有辦法寫摘要。摘要儲存了論文的所有識別碼(關鍵字)，網路搜尋引擎正是根據摘要所提供的識別資料進行相關主題搜索。摘要應包含下列資料(1)簡略地描述研究背景，(2)敘述研究目的及主要的研究活動，(3)描述研究方法，(4)概述最重要的結果，(5)簡述主要的結論或建議。以 2~3 個句子簡短介紹以上每項資料，摘要的長度約在 300~500 字之間。摘要與結論雖然都是關於整篇論文的歸納與整理，但兩者的目的與功能有很大的不同。摘要相當於精彩畫面預告，是要讓未看過論文的人看的，目的是要吸引讀者閱讀;結論是經典畫面重播，是要讓已看過論文的人看的，目的是要加深讀者印象。

論文的組成架構 \neq 論文的寫作順序

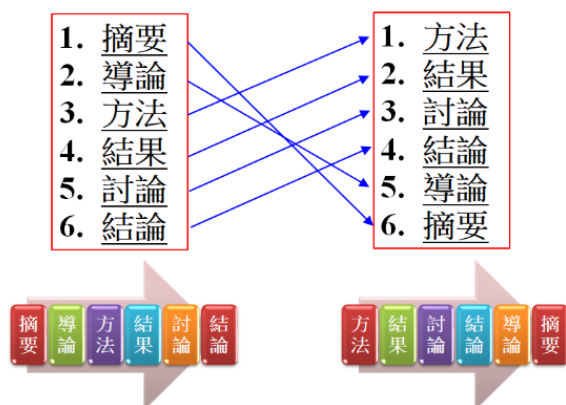


圖 1. 科技論文的組成順序與寫作順序不同。



圖 2. 摘要是濃縮版的論文，所以等論文內容全部確定後，才能開始撰寫。

1. 導論(Introduction)

導論是將論文放在某一專業領域中，從宏觀的角度來比較該論文與其他論文，從而定位出該論文的貢獻與重要性。導論這一節是決定論文能否被接受的關鍵，所以作者必須知己知彼，清楚整個領域的研究現況，同時點出論文的不同與創先之處(參考圖 2)。



圖 3. 導論是要在眾多文獻中找到自己論文的位置

『導論』這一章節的位置是放在摘要之後，但是導論通常是等到研究結果與討論出來以後才開始撰寫，因為這個時候作者才能完全確定自己的論文在眾多文獻中的獨特之處。導論的內容包含下列六個主題[1,2]:

- (1) **背景資料**: 為這篇論文所要探討的問題提供背景知識。
- (2) **文獻回顧**: 簡介其他學者對於此問題曾經發表的研究。
- (3) **指出問題**: 在既有文獻中對於該問題的研究還有哪些不夠周詳的地方。

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- (4) **指出目的**:作者提出這篇論文研究的具體目的。
- (5) **指出貢獻**:指出本研究在理論上或應用上的價值,或指出不同與創新之處。
- (6) **組織架構**:說明本論文的組織架構,。

1.1 背景資料

在介紹背景資料時,其範圍要從大到小,先指出和研究內容相關的一個大領域 A,再把焦點轉到此大領域中的一個次領域 B,最後再將焦點轉到此次領域 B 中和本研究有密切關聯的更狹窄主題 C。例如考慮下列由大到小的背景資料:航太工程→飛行控制→飛彈控制→飛彈強健控制→飛彈順滑模式強健控制,其中最後的箭頭才是論文要探討的主題。除了導論,論文標題的選擇也必須能反映這種多層次的背景關係,越是冗長的標題,代表論文的主題越專越細。書的標題通常較短,就是因為它探討的主題很廣。

在介紹背景資料時,所使用的時態可用現在式或現在完成式。

- 當背景資料是在介紹某個研究領域中的普遍事實時,動詞用現在式
 1. Managers of data-processing centers often **find** it practical to establish programming standards.
 2. Comprehension **is involved** in nearly all aspects of programming work, including writing, debugging, and modifying software.
 3. The use of programming standards **may make** programs easier to comprehend.
- 當背景資料是在介紹某個研究領域裡的最近某種趨勢時,動詞要用現在完成式,這是在描述過去一直持續到現在的趨勢。
 1. As the standard of living has improved in the last ten years, beer, a Western beverage, **has become** very popular in China.
 2. In recent years, a variety of standards **have been proposed** in the literature.

1.2 文獻回顧

科技論文投稿最常犯的錯誤之一,是論文中沒有引述足夠的相關研究,用以清楚表達作者研究的動機及重要性。作者必須透過與其他文獻的必較,提出自己的論文在眾多已發表的文獻中,有何不同與創新之處,如此審稿人才能判斷該篇文章能否增進該領域的知識。文獻回顧的動作必須在做研究之前就開始進行,否則等研究做完,才發現論文成果與某文獻完全相同,此時再改變研究主題為時已晚。

引述文獻的順序有三種:

- **依與主題的密切程度排列**:先提密切程度較淺的文獻,然後提密切程度較深的文獻。這種引述方式適用於新建立的研究領域,用以介紹與其他既有領域文獻的相關性。

- **依時間的遠近排列**:同一主題被研究很久,在不同的年代有不同的代表作出現,適用於以年代的順序引述文獻。

- **依不同的研究路線排列**:這種文獻引述方式適用於同一主題有不同的研究路線。例如流體力學有理論分析、數值計算、風洞實驗,三種不同的研究路線。

引述文獻常用句型有四種:(1)資料導向引述,(2)研究領域的一般描述,(3)多作者導向引述,(4)單作者導向引述。文獻回顧通常以前三種的引述之一開頭。在一、二個這種引述之後,作者接著採用第四種引述。當文獻回顧包含二個以上小節時,則每一小節的主題句都採用前三種引述之一,小節的最後再回到第四種引述[3]。

(1) 引述文獻句型 1:資料導向引述

現在完成式:當所引述資料是描述某種趨勢或變動

- The computer **has become** an important educational tool in the past decade (Johnson, 1983).
- Outbreaks of dengue fever **has increased** in recent years [10].

過去式:當所引述資料是陳述過去的事件

- The original treatment guidelines were published in 1989 [5].

(2) 引述文獻句型 2:研究領域的一般描述

此種引述通常放在段落的前幾句,內容則是大家公認的事實,所以一般不需引述參考文獻。由於所描述的內容是從過去持續到現在的一種研究趨勢,所以使用現在完成式。在這種公認事實的引述中,研究主題才是討論的焦點,而從事研究工作的人並不是重點,所以這種引述通常採用被動語態。

| 研究程度 | | 現在完成式(被動) | 主題 |
|------------------------------|---------------------|--|---|
| Much Little No | work research | has been done on has been devoted to has been performed on | the differences between advertising styles used in different countries. |
| Much Little | attention | has been devoted to has been directed toward | the effects of boron doping. |
| Many A number of Several Few | studies experiments | have been conducted on have been done regarding have been published on | the prevalence of back pain in helicopter pilots |

若將主題當作主詞,則通常會提到特定的一段時間。

| 主題 | 現在完成式 | 研究程度 | 時間 |
|---|----------------------------|---|--|
| The problem of back pain in helicopter pilots | has been | the subject of much research | in recent years. in the last decade. since 1990. |
| | | the focus of a great deal of research | |
| | has drawn has attracted | much attention much interest little attention | |
| | | has been extensively examined has been widely discussed has been thoroughly investigated has seldom been discussed | |

(3) 引述文獻句型 3:多作者導向引述

使用一個句子來引述二個以上學者曾進行的研究,可分成主動語態與被動語態:

● 主動語態

| 多作者 | 現在完成式(主動) | 主題 | 參考引述 |
|---|--|--|------------|
| Several researchers A number of authors Many investigators Few writers | have studied have investigated have examined have explored have reported on have discussed have considered | the role of computers in classroom instruction | [5, 9-13]. |

● 被動語態

| 主題 | 現在完成式(被動) | 多作者 | 參考引述 |
|--|--|---|--|
| The role of computers in classroom instruction | have been studied have been investigated have been examined have been explored have reported on have been discussed have been considered | by several researchers by a number of authors by many investigators by few writers | (Yang, 1989; Smith, 1990; Roberts, 1992) |

(4) 引述文獻句型 4:單作者導向引述

引述單個參考文獻的句子稱為『單作者導向引述』。這種引述是針對與自己研究最相關的個別文獻。在文獻回顧的過程中，當資料導向引述及多作者導向引述完成後，緊接著就是單作者導向引述，由於這一部分是與自己的研究關係最密切的文獻，所以必須逐一討論每個文獻作者的研究成果。

● 單個句子引述單作者

| 作者 | 過去式(主動) | that | 研究結果 |
|----------------------------|---|------|---|
| Chen (1992) Rogers [20] | showed found reported suggested observed Pointed | that | the use of computers in a high school classroom enhanced creativity and independent thinking. |

● 二個句子引述單作者

| 作者 | 過去式(主動) | 主題 | 研究結果 |
|-------------|---|-----------------------|--------------------|
| Chen (1992) | studied examined investigated explored | the effect of X on Y. | He found that |

- 在單或多作者導向的引述句中，都包含二個動詞。第一個為主要動詞，描述被引述之學者的活動，第二個動詞則出現在以 that 開頭的名詞子句中，這動詞描述該學者所提出之資料。

- 當第二個動詞描述的是不受時間影響的事實時，用現在式：

| 作者 | 過去式動詞 | that | 研究成果 現在式動詞 |
|--------------|----------------------------|------|---|
| Marks (1932) | showed | that | water boils at 100°C. |
| Gorden [5] | found reported noted | | the gravity of the largest moon affects the orbits of the other moons. |

- 當第二個動詞描述的是學者曾經提出的方法，但該方法已成為一種標準，且仍然有人繼續在用時，則仍視為不受時間影響的事實，用現在式

| 作者 | 過去式動詞 | 受詞 | 研究成果 現在式動詞 |
|---------------|-------------------------|---|---|
| Rogers (1990) | developed introduced | an algorithm a technique a method | that solves the problem quickly. |
| Chen [3] | designed proposed | | that produces a clear image. |

- 當第二個動詞描述的現象只是在特定情形下才有效，或是還未被接受為不受時間影響的事實時，則 that 子句中的動詞要用過去式

| 作者 | 過去式動詞 | that | 研究成果 過去式動詞 |
|--------------|----------------------------|------|---|
| Bolan (1988) | observed | that | young girls scored higher than boys on communication skills. |
| Reed [6] | found reported noted | | reducing the amount of oxygen caused the decomposition rate to drop sharply. |

- 當第二個動詞描述的資料只不過是一些假設或建議時，則 that 子句中的動詞要用現在式，並在動詞前加上如 may 之語態助動詞，同時將第一個動詞改為臆測動詞:[3]

| 作者 | 過去式之臆測動詞 | that | 現在式動詞 加上語態助動詞 |
|-------------|---|------|--|
| Ross (1990) | suggested hypothesized argued proposed | that | reducing the duration of school vacations may help children to retain more of what they learn in class. |

- 介紹學者研究的常用套句

1. (人名)... shows in full detail that (how, etc.) ...
2. ... studied (explored, etc.) the problem (phenomenon, etc.) of ...
3. (人名)... (discusses, considers, etc.) the equation of ...
4. (人名)... advanced (propounded) a theory that ...
5. (人名)... developed the idea a little further.
6. A close study on ... was made at ABC university, and it revealed that ...
7. In the research, ... (人名) discovered (found) that ...
8. In his recent survey on ..., (人名) has taken some important steps in this direction.
9. The first scholar to give much attention to ... was (人名).
10. (人名) is among those who noted (observed) that ...

1.3 指出問題

導論的前二步驟已敘述過研究主題的背景資料，並討論了其他學者的相關研究。導論的後半段就要將焦點轉到作者自己的研究問題上。步驟三是根據文獻回顧的結果，指出在過去的相關研究中，存在尚未處理的問題或衍生的新問題。這些問題包含：(1)以前學者尚未研究或處理不夠完善之課題，(2)過去研究所衍生的新問題，

(3)過去存在二個以上互相衝突的觀點或理論，其爭議有待釐清。

指出了問題所在後，才能形成論文的研究動機，也才有步驟四的研究目的。

- 信號字眼『**however**』的出現暗示作者要開始指出過去研究的不足之處，然後緊跟著 few, little, no 等字眼，表示目前仍缺少某些資料。

| 信號字眼 | 使用如few, little, no之信號字眼以指出過去研究之不足 | 研究主題 |
|-----------------|---|-----------------------|
| However, | <p>few studies have been done on</p> <p>few studies have been reported on</p> <p>few studies have been published on</p> <p>few researchers have studied</p> <p>no studies have investigated</p> <p>little research has been devoted to</p> <p>little attention has been paid to</p> <p>little information has been published concerning</p> <p>no work has been done on</p> <p>little literature is available on</p> <p>there is little literature available on</p> <p>little is known about</p> <p>insufficient data are available on</p> | surface-residue loss. |

- 另一種指出問題的句子是採用複合句。其中第一個子句描述某個課題的研究程度，第二個子句則指出另一個相關課題的研究不足。

| 信號字眼 | 主題一的研究程度 | 主題二的研究程度 |
|---------------------------------|---|--|
| Although While | <p>much work has been done on X,</p> <p>much research has been devoted to X,</p> <p>many researchers have investigated X,</p> <p>many studies have been published concerning X,</p> <p>much literature is available on X,</p> | <p>little research has done on Y.</p> <p>little attention has paid to Y.</p> <p>little information is available on Y.</p> <p>little work has been published on Y.</p> <p>few researchers have studied Y.</p> <p>few studies have investigated Y.</p> |

指出研究問題的句子都是採用現在式或現在完成式，用以表示目前的狀態或到目前為止的一種趨勢。注意 work, literature, research 及 attention 等字詞皆為不可數，修飾詞應使用 much, little, 或 no。Studies, papers, researchers 及 investigators 等字詞皆為可數，修飾詞應使用 many, few 或 no。

1.4 指出研究目的

指出問題之後，作者接著用一、二句話敘述論文的研究目的。

- 指出問題：

... To date, **however**, no studies have attempted to measure surface-residue loss without employing litter bags. This is a notable shortcoming, because the use of litter bags in previous studies may have resulted in underestimation of residue loss

- 指出目的：

The objective of the present study was to determine rates of loss of wheat residues left directly on the soil surface in different wheat-growing regions. In addition, we monitored changes over time in the percentage of soil surface covered by residues.

介紹研究目的的二種句型：

- 句型 1:以 purpose, aim, objective 等名詞來直接敘述研究目的

1. **The objective of this research** was to determine the impact of the N-application rate during the early portion of the sugarcane growth cycle on the NO₃ distribution in the soil profile.

2. **The purpose of this experiment** was to examine whether listener's gender affects their response to background profile.

- 句型 2:以主要子句描述研究活動，同時利用不定詞片語來敘述研究目的

1. An empirical study was carried out **to investigate** the effect of indentation on program comprehension.

2. **To investigate** the prevalence of back pain in helicopter pilots, a survey was conducted of all licensed helicopter pilots in three provinces of the country.

在介紹研究目的時，可以將論文本身當作焦點，稱為論文導向；也可以將研究活動當作焦點，稱為研究導向。

- 當作者採用論文導向介紹時，句子會使用 paper, report, thesis 或 dissertation 等字詞來直接提到論文本身，而且因為研究論文提供資料的行為為不受時間影響之事實，所以此種句子通常使用現在式。

| 論文導向(現在式) | 研究主題 |
|--|--|
| <p>The purpose of this paper is</p> <p>The aim of this report is</p> <p>The objective of the present paper is</p> | <p>to analyze the effect of X on Y.</p> <p>to determine whether X can be used to increase Y.</p> <p>to show that X is superior to Y.</p> |
| <p>The present paper reports</p> <p>This thesis describes</p> <p>This letter presents</p> <p>This paper proposes</p> | <p>the results of experiments in which X was mixed with Y.</p> <p>a proof that X can be reduced to Y.</p> <p>a new method of synthesizing X.</p> |

- 論文導向的研究目的也可以使用未來式，因為資料『將要』在論文中被提出來。

| 論文導向(未來式) | 研究主題 |
|--|--|
| <p>This paper will propose</p> <p>This thesis will present</p> | <p>a new method of synthesizing X.</p> <p>several approaches to improving X.</p> |
| <p>In this paper, we will argue</p> <p>In this report, we will attempt to show</p> | <p>that Smith's hypothesis is false.</p> <p>that X is equivalent to Y.</p> |

- 以研究導向描述研究目的，則是用在當要提出某些調查或實驗結果時。在使用研究導向時，句子中會出現 study, research, investigation, experiment 等字眼來代表研究活動本身。又因為論文發表之時，研究活動已結束，所以必須使用過去式。

| 研究導向(過去式) | 研究活動(過去式) |
|---|--|
| <p>The purpose of this experiment was</p> <p>The aim of this study was</p> <p>The objective of this research was</p> | <p>to analyze the effect of X on Y.</p> <p>to determine whether increasing X affected Y.</p> |
| <p>In the experiments reported here,</p> <p>In the research described here,</p> <p>In this research,</p> <p>In the present investigation,</p> | <p>this theory was tested by examining X.</p> <p>we investigated the effects of X.</p> <p>samples of X were tested by placing them in Y.</p> <p>a survey of X was conducted.</p> |

- 在介紹自己的研究目的時，注意句子內一定要至少有一個名詞片語(如 this paper, the experiment reported here)能夠清楚表示是指作者本身的研究，而不是其他學者過去的研究。

| | | |
|---|----|---|
| In summary, previous methods are all extremely inefficient. Hence a new approach is developed to process the data more efficiently. | 修正 | In summary, previous methods are all extremely inefficient. In this paper , a new approach will be developed to process the data more efficiently. |
| 無法分辨是誰的研究 | | 清楚表示是作者本身的研究 |

1.5 指出貢獻

作者指出研究的目的後，接著提出論文的貢獻。不管是期刊論文或碩博士論文，作者都必須提出自己論文的創意或貢獻，才能取得審查委員的認同。論文可能的貢獻包含下列幾點：

1. 提出某種新理論，解釋了原先無法解釋的現象。
2. 擴充了已知理論的適用範圍，使其能解決更多問題。
3. 對於某些經驗公式或假設，提出其背後的學理基礎，並加以修正或改良。
4. 對於已存在的理論，提出一個新的應用方向。
5. 改良既有的技術或演算法，使其更有效率。
6. 以實驗方法發現新的產物或現象。
7. 改進實驗技巧，讓某些產物或現象的出現更加容易。
8. 應用既有的理論或技術到產業界，發明新產品，或改善原有產品的品質。

以下列出論文貢獻的幾個範例。

● 學理上的貢獻

1. The results of this study **may help to explain** how the amount of fluorine incorporated into the films is affected by the presence of water in the immersion solution.
2. Our results **may help to clarify whether** the fission hypothesis or external origin hypothesis is valid.
3. The results of this survey **may aid researchers in better understanding** the adverse health effects of long-term exposure to whole-body vibration.
4. Further data of this kind **are of importance for the understanding** of ion-beam-induced oxidation of silicon.

● 應用上的貢獻

1. This research **may provide a useful reference for** researchers and managers attempting to increase employee productivity through optimization of the work environment.
2. The results reported here **could be beneficial to** educators attempting to design more effective language programs.
3. Data from this research **may help other factories to** reduce the impact of acidic effluent on the local environment..
4. The **information should aid in the design of** management schemes that will optimize the benefits of crop residues remaining on the soil surface..

- 結合研究目的與貢獻的句型：研究目的及研究貢獻，也可以透過介係詞片語、不定詞片語或關係子句，而將兩者結合起來。

| 步驟四：研究目的 | 步驟五：研究貢獻 |
|--|--|
| The objective of this study was to collect data on the results of various teaching methods | for reference in designing more effective language teaching programs. |
| This paper describes a new channel assignment algorithm | in order to design more effective language teaching programs. |
| This report presents experimental data on ozone decomposition | that may significantly increase quality of service and system utilization. |
| | that may be of importance in explaining the breakdown of atmospheric ozone. |

- 以謙虛或試探性的態度指出研究價值：科技報告的作者很少直接宣稱自己的研究結果能完全解決某個問題，縱使作者對結果很有信心，通常也只會表示這些結果能幫助我們解決某個問題，或提供一種可能的答案。為了表達這種謙虛的態度，作者在指出論文的研究價值時，會使用語態助動詞表示臆測或試探的態度。其中最常用的助動詞有 may、should 及 could。

| 研究結果 | 語態助動詞 | 價值 |
|--------------------------------------|------------------------|---|
| Our results | may help | to clarify whether the fission hypothesis or external origin hypothesis is valid. |
| The technique presented here | may facilitate | the development of advanced robotic vision systems. |
| The proposed technique | could be | useful in maximizing the efficiency of systems with heavy traffic. |
| The analysis presented in this paper | should simplify | the task of finding a comprehensive solution. |

● 各種語態助動詞所表示的確定程度

| 助動詞 | 確定程度 | 例句 |
|---------------|-----------------------|---|
| will | 最確定：表示作者一點也不懷疑句子的內容 | The results of this experiment will provide further data concerning the performance of the two systems. |
| would | 在某些條件下很確定：只要條件被滿足，就確定 | If a second processor were added, the system would run 40% faster. |
| should | 可能性高，但不完全確定 | This modification should improve the efficiency of the system, but it has not yet been tested in practice. |
| may | 有可能，但作者不確定是否會發生 | These findings may be useful to researchers attempting to increase employee productivity. |
| might | 同上，但比較不確定 | These data might help to clarify whether the fission hypothesis is valid. |
| could | 作者更不確定是否會發生 | Our results could be beneficial to educators attempting to design more effective language programs. |

1.6 組織架構

對於碩博士論文或是長篇論文，導論的最後都要加入組織架構的說明，方便讀者快速查閱。

The paper is organized as follows. **Section 2** presents the dynamic models and problem formulation. **Section 3** introduces the controller structure for the idea case, in which the exact dynamics and environment parameters are known. **Section 4** presents the proposed adaptive scheme and the main stability result. **Section 5** presents stronger analytical results for the single-link case. In **section 6**, the robustness of the scheme is discussed. **Section 7** discusses simulation results for the single revolute link case. Finally, **section 8** offers brief concluding comments.

- 論文組織架構的開頭會使用下列的主題句

1. The organization of this report is as follows.
2. This paper is organized as follows.
3. The remainder of this paper is organized as follows.

● 組織架構內的說明文字可用現在式或未來式

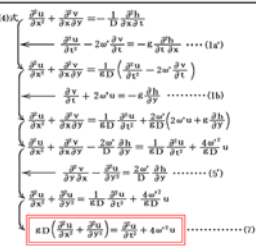
| 現在式 | 未來式 |
|---|--|
| Section 2 presents the basic analysis and describes the proposed method for finding solution. | Section 2 will present the basic analysis ... |
| Section 3 describes simulations in which the proposed algorithm was tested using three data sets. | Section 3 will describe simulations in ... |
| In section 4, we present experimental results that confirm the effectiveness of the proposed method. | In section 4, we will present experimental ... |
| Section 5 summarizes the conclusions of the paper. | Section 5 will summarize ... |
| Section 5 presents concluding remarks | Section 5 will present concluding remarks. |
| The conclusions of the paper are stated in section 6. | The conclusions of the paper will be stated ... |

2. 方法(Methodology)

方法章節介紹本篇小論文所根據的數學、物理理論或實驗方法[6]。內容包含:(1)主要的研究活動:作者做了甚麼事情?(2)研究活動的目的:做這些事情的目標是甚麼?(3)進行研究的理由或背景:進行這研究的動機是甚麼?(4)介紹研究所使用的方法及工具。


方法(Methodology):介紹研究工具
確認讀者可用相同的工具複製出相同的結果

數學工具



- 提出數學模型或主要方程式。
- 說明相關假設、條件及定義。
- 進行數學分析或計算。

實驗工具



- 介紹所採用的材料、儀器及設備。
- 解說實驗程序。
- 說明數據收集與分析的方法。

圖 2. 方法章節介紹所使用的數學或實驗工具

2.1 方法章節中的數學分析

- 內容涵蓋:(1)介紹題目,(2)說明相關假設、條件或定義,(3)敘述主要問題及基本方程式,(4)進行分析、推導並得出結果,(5)討論所獲結果的正確性或限制。
- 數學分析的撰寫原則:(1)清楚敘述所有假設之後,才可應用這些假設進行推導,(2)一次只討論一個數學問題,等前一個問題討論完,再討論下一個,並且清楚說明不同問題間之邏輯關係,(3)不預先假設讀者一定了解論文中所有細節,應一步一步清楚說明數學分析中的所有細節。

In the absence of friction and other disturbances, the joint-space dynamics of an n -link constrained rigid robot manipulator can be written as

$$H'(q)\ddot{q} + C'(q, \dot{q})\dot{q} + g'(q) + J^T(q)f_e = \tau \quad (1)$$

where q is the next $n \times 1$ vector of joint displacement, τ is the $n \times 1$ vector of applied joint torques (or forces), $H'(q)$ is the $n \times n$ symmetric positive definite manipulator inertia matrix, $C'(q, \dot{q})\dot{q}$ is the $n \times 1$ vector of centripetal and Coriolis torques, $g'(q)$ is the $n \times 1$ vector of gravitational torques, $J(q)$ is the $n \times n$ manipulator Jacobian matrix, which is assumed to be non-singular, and f_e is the $n \times 1$ vector of forces/moments at the end-effector. We assume that the manipulator described by (1) is non-redundant. We also assume that the robot is equipped with joint position and velocity sensors and a force sensor at its end-effector.

Now let us derive the Cartesian-space arm dynamics. Following Slotine and Li (1987), we first fix a frame of reference R_0 on the robot base and then use a set of independent parameters x , composed of the Cartesian position and Euler angles of the end-effector, to represent the end-effector configuration. Since the manipulator is assumed to be non-redundant, the vector x is also an $n \times 1$ vector, and in a singularity-free region, it represents a set of generalized coordinates that completely describes the manipulator's motion. The relationship between joint positions and the end-effector configuration is

$$x = f(q) \quad (2)$$

with the corresponding velocity relation

$$\dot{x} = J(q)\dot{q} \quad (3)$$

where $J(q) = \partial f(q) / \partial q$ is the Jacobian matrix.

- 方程式是文章的一部分, 需要遵守標點符號的使用規則。

Consider a unitary matrix B whose eigenvalues $\mu_1, \mu_2, \dots, \mu_n$ all lie on the unit circle. Let $P_N(z)$ be a polynomial that has a peak at $z = 1$ and is constructed to be close to zero on the unit circle away from the vicinity of $z = 1$. Let the eigenvectors of B be g_1, g_2, \dots, g_n and the initial vector v_0 be expanded as $v_0 = \sum_{j=1}^n \alpha_j g_j$. We have

$$u(\lambda) = P_N(e^{-i\lambda})v_0 = \sum_{j=1}^n \alpha_j P_N(e^{-i\lambda} \mu_j) g_j$$

Clearly, if λ is chosen such that μ_{j_0} is close to $e^{i\lambda}$ and other eigenvalues of B are not "close" to $e^{i\lambda}$, then the coefficients of g_j will be small except when $j = j_0$. Thus $u(\lambda)$ can be regarded as an approximation to the eigenvector of μ_{j_0} . If the polynomial $P_N(z)$ is written as

$$P_N(z) = \sum_{j=0}^{N-1} \beta_j z^j$$

then we have that

$$u(\lambda) = \sum_{j=0}^{N-1} \beta_j B^j v_0 e^{-i\lambda j}$$

$$= \sum_{j=0}^{N-1} \beta_j v_j e^{-i\lambda j}$$

where $v_j = B^j v_0$. Therefore, if the vectors v_j are computed first, the fast Fourier transform can be used to compute $u(\lambda)$ at many different values of λ simultaneously.

- 關於數學或邏輯關係的描述, 應採用現在式, 因為這些都是不受時間影響的事實:

1. Consider a unitary matrix B whose eigenvalues all **lie** on the unit circle.
2. Then we **have** the following equation:
3. If A **is** chosen such that $A_1 = B_1$, then the two expressions are equivalent.
4. We **assume** that a social planner controls the rate of production of all energy resources.
5. The solution **can** be obtained by solving Eq. (2.13).

- 介紹新題目或轉接到新的段落時, 可用未來式

1. We **will now discuss** the nonlinear case.
2. In the next subsection, we **will show** how to solve this equation.
3. If an appropriate value of ρ is given, then the coefficient of a_{ij} **will be** large.

- 數學分析章節中的語法:採用自然、易讀的寫作方式, 就好像直接在向讀者說話一般。因為進行數學分析的人是作者自己, 主詞用 **we** 的主動語法在這裡最為

恰當，盡量避免以 it is, there is, there are 作為句子的開頭。

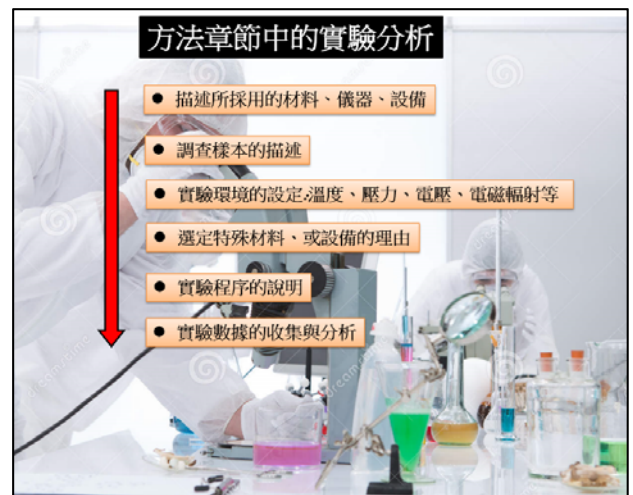
| 生硬 | 自然 |
|--|---|
| It is assumed here that the social planner controls the rate of production of all energy resources. | We assume that the social planner controls the rate of production of all energy resources. |
| Before describing the adaptive controller in detail, the ideal case in which the dynamic model is exactly known will be considered. (句首的片語缺少修飾的對象) | Before describing the adaptive controller in detail, we will consider the ideal case in which the dynamic model is exactly known. |
| The relationship between these two variables will now be considered. | Now let us consider the relationship between these two variables. |

● 數學分析章節常用套句

1. Consider the case in which A is equal to B.
2. As an example, consider the case in which $A = B$.
3. Let A be equal to B.
4. If $A = B$, then we have the following equation: [列出方程式]
5. This problem can be written as ... [列出方程式]
6. This problem can be expressed as ... [列出方程式]
7. This problem can be written as follows: [列出方程式]
8. Substituting A into Eq. (2), we obtain ... [列出方程式]
9. We will now integrate Eq. (3) in order to derive the solution.
10. A is inversely proportional to B, as shown below.
11. The relationship between A and B is as follows: ... [列出方程式]
12. The relationship between A and B can be expressed as ... [列出方程式]
13. The solution is ... [列出方程式]
14. We can now derive the solution to Eq. (2.3).
15. We will now reduce Eq. (20) to a simpler form.
16. Given these assumptions, the system can be modeled as follows: [列出方程式]
17. Under these assumptions, the equation can be rewritten as shown below.

2.2 方法章節中的實驗分析

內容涵蓋:(1)描述所採用的材料、儀器、設備，(2)調查樣本的描述，(3)實驗環境的設定:溫度、壓力、電壓、電磁輻射等，(4)選定特殊材料、或設備的理由，(5)實驗程序的說明，(6)實驗數據的收集與分析。



● 描述實驗程序的時態原則:

1. 寫作論文時，實驗已完成，故描述實驗中的步驟應使用過去式。
 - The experiment **was conducted** at a large university in the Midwest.
 - The 72 subjects **were randomly divided** into three groups.
 2. 當作者敘述一般不受時間影響的事實時，應使用現在式。
 - Typical enrollers in this course **include** computer science and engineering students.
 3. 當作者敘述一般學者常採用的標準程序時，應使用現在式。
 - In this type of procedure, subjects **are randomly assigned** to one of several groups.
 - Subjects in all groups **perform** the same tasks.
 4. 當作者指稱自己研究報告的其他部分時，應使用現在式。
 - The tests for the control and “excessive” indentation groups **are shown** in Figure 5.
- ### ● 描述實驗程序的語態原則
1. 這一章節所要描述的主角是實驗的設備與材料，而非實驗的操作者，故句型採用被動語態。
 - The **samples were immersed** in an ultrasonic bath for 3 minutes in acetone followed by 10 minutes in distilled water.
 - To evaluate the influence of nitrogen and carbon monoxide on SiO₂ sputtering, two experiments **were performed** in which these gases were introduced through the leak valve during sputtering.
 2. 當作者在敘述自己的假設或建議時，語態改成主動的形式較佳。
 - For the second trial, the apparatus **was covered** by a sheet of plastic. It **was believed** that this modification would reduce the amount of scattering.

第一句維持被動，第二句改成主動

- For the second trial, the apparatus **was covered** by a sheet of plastic. **We believed** that this modification would reduce the amount of scattering.

● 描述實驗設備的時態

1. 當使用的儀器是自己領域中一般學者常用的標準設備時，對該設備的描述使用現在式：

- A twin-lens reflex camera **is** actually a combination of two separate camera boxes.
- The viewing box **is used** only for viewing and focusing.

2. 當使用的儀器是在過去為了特定用途而設計，而非一般學者所使用的標準設備時，對該設備的描述使用過去式：

- The probes **consisted** of pieces of narrow plastic tubing inserted through wider pieces of plastic tubing, so that the smaller tubing **extended** 2cm beyond each outer pieces on one end and 8cm beyond on the other end.

3. 從描述實驗設備所使用的時態即可以推論該設備是作者為特殊用途而設計，或是一般學者所使用的標準設備

- The sample holders **were** specially designed to present slippage during measurement. The sample **was** held by special aluminum tabs covered with sandpaper.

過去式

代表設備是為實驗而特別設計

- The sample holders **are** specially designed to present slippage during measurement. The sample **is** held by special aluminum tabs covered with sandpaper.

現在式

代表設備是任何人都可購得的一般標準設備，

3. 結果(Results)

結果章節是以圖形、表格、數據曲線呈現論文的研究成果。內容包含：(1)說明圖表數據的趨勢和含意：讓數據說話，(2)概述主要的研究結果：數學分析或實驗分析獲得甚麼？(3)說明結果的重要性，(4)對結果的評論和推論：數據所支持的論點是甚麼？。

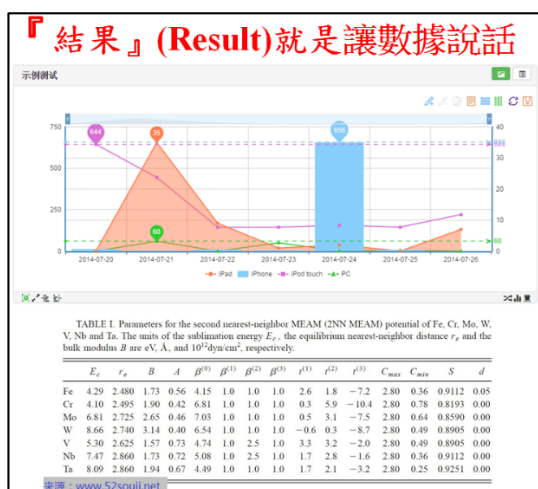


圖 3. 一幅美麗的圖表勝過千言萬語

● 三段式看圖說故事



1. 首段說背景：說明該圖的背景資料，定義曲線、符號、數據點所對應的物理量。
2. 中段說趨勢：接著說明曲線或數據所呈現的趨勢及特點。
3. 後段說推論：最後說明根據觀察到的趨勢及特點可得到哪些推論或預測。

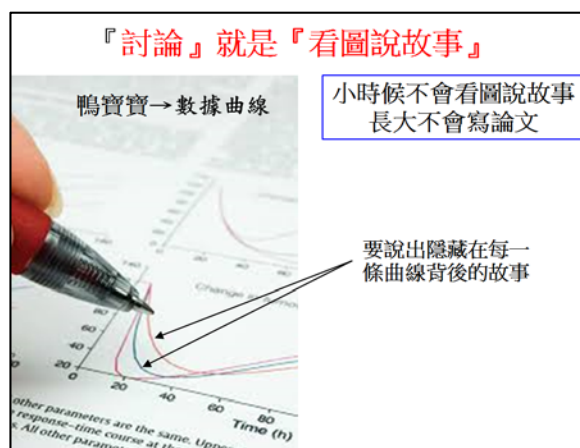
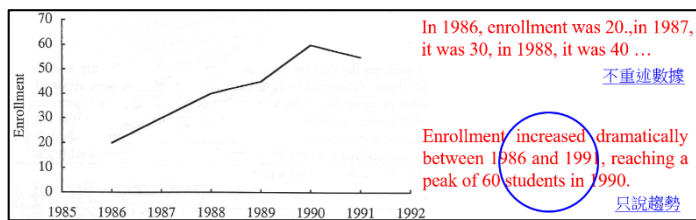


圖 4. 討論就是看圖說故事：小時候不會看圖說故事，長大不會寫論文。

- 圖表本身應含足夠的資訊，讓讀者在不看文的情況下，亦能瞭解圖表的內容。
- 文字是用來說明圖表的趨勢，而不是重複述說圖表中已有的數據。
- 圖表自己要會說話：一張圖表如果必須配合大量的文字說明才能呈現它的意義，代表該圖表設計不良，需要重新繪製。
- 文字只是用來說明圖表中的數據趨勢是否支持作者的解釋或推論。



- 介紹圖表時所使用的語態:在決定要採用主動或被動語態時,要考慮二件事情:1.句子的焦點,2.作為主詞的名詞片語的長度。
- 結果章節內的主角當然是結果本身,所以應把指稱結果的名詞片語當作主詞,但是如果很長的名詞片語當主詞,將造句子不自然。

The variation in the temperature of the samples over time is shown in Figure 3.

以描述結果的名詞片語當主詞雖然正確,但太長了
修正: Figure 3 shows the variation in the temperature of the samples over.

- 顯示結果的動詞:(1) show, present, display,圖與表均可用;(2) summarize 只用於表;(3) depict, illustrate 只用於圖。
- 另一種常用的方法是直接敘述結果,並在劇中插入一個片語或括號中的說明,以告訴讀者這些結果在哪個圖表中列出。

1. The temperature increased rapidly, as shown in Figure 1.
2. The temperature increased rapidly, as Figure 1 shows.
3. As shown in Figure 1, the temperature increased rapidly.
4. As Figure 1 shows, the temperature increased rapidly.
5. The temperature increased rapidly (see Figure 1).

- 敘述研究結果所使用的時態

1. 敘述由實驗所獲得的成果,通常用過去式
- After flights of less than two hours, 11% of the army pilots and 33% of the civilian pilots **reported** back pain.

- The animals in the red group **chose** the red ball significantly more often than they **did** the white ball.

2. 敘述由理論模型所獲得的成果,通常用現在式(數學式的成立不受時間影響)

- After simplification, Eq. (3) **turns** out to be the well-known Schrödinger equation.

3. 敘述由實驗所獲得的成果,若使用現在式時,那麼作者認為他所揭露的結果是一種普遍的事實

- Female listeners **find** loud music more irritating than male listeners **do**.

- 描述數據趨勢的三種句型

1. 某個參數在時段中變化所產生的影響

| 參數 | 過去式動詞 | 時間 |
|-------------------------------|---|------------------------------|
| Enrollment in medical schools | increased (decreased), rose (fell) dropped (declined), went up (down) remained constant (unchanged) | from 1985 to 1990. |
| The temperature | reached a maximum (minimum) | after oxygen was introduced. |

2. 不同樣本、方法之比較

| 第一個項目 | 比較/過去式/ | 第二個項目 |
|----------------|-------------------------------|-----------------|
| The new method | was faster than (slower than) | the old method. |
| Older workers | scored higher (lower) than | younger workers |

3. 不同參數間之關係或影響

| 第一個項目 | 比較/過去式/ | 第二個項目 |
|--------|---|-------------|
| Grades | were correlated with (related to) were dependent on (independent of) | study time. |

| 第一個參數 | 過去式動詞 | 連接詞 | 第二個參數 | 過去式動詞 |
|-------------|-----------------------|------|------------|-----------------------|
| Test scores | increased (decreased) | as | study time | increased (decreased) |
| | rose (fell) | when | | rose (fell) |

- 對於研究結果的評論:(1)依據研究結果所得到的推論,(2)解釋產生某項研究結果的原因,(3)比較其他學者的研究結果,(4)指出實驗結果與所根據的理論模型是否相符。

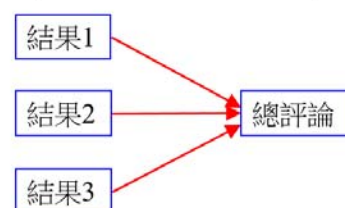
系列式的評論

對一個結果,做一個評論;對多個結果,一次一個,依序進行



綜合式的評論

先介紹幾個不同項目的結果,然後對這些結果做綜合的評論。



- 對研究結果所做的推論使用現在式動詞

- 以語態助動詞 may 所引導的推論

1. The level of indentation **may** have an effect on students' test score.
2. The higher incidence of back pain in civilian pilots **may** be due to their greater accumulated flying time.
3. One reason for this group's higher scores **may** be that the group was already accustomed to working with Pascale

- 以臆測動詞 appear, suggest, seem 加上 that 開頭的名詞子句

| 主詞 | 臆測動詞/現在式/ | 說明 |
|----------------------|--|--|
| It | seems (appears) is likely (is possible) | that the drug reduces the frequency and intensity of allergic reactions. |
| These data (results) | indicate (suggest, imply) | |

- that 開頭的名詞子句可用現在式或過去式,各有不同的含意

1. It seems that the drug **reduces** the frequency and intensity of the allergic reactions. (作者認為此一推論在一般情形下均有效)

2. It seems that the drug **may reduce** the frequency and intensity of the allergic reactions. (作者認為此一推論可能在一般情形下均有效，但不十分確定)
3. It seems that the drug **reduced** the frequency and intensity of the allergic reactions. (作者認為此一推論只在特定情形下有效)

4. 討論(Discussion)

對於研究結果的討論，包含下列幾個項目：

1. 研究目的：用一句話再次指出研究的主要目的。
2. 結果概述：指出結果的重要性，指出結果與原來的假設或別人的結果是否相符？
3. 對於結果的說明：作者對自己的結果提出說明、解釋或猜測。
4. 推論：研究結果所能支持較為廣泛的立論。
5. 研究方法或結果的限制：指出研究的限制，及可能產生的影響。
6. 研究結果的實際應用：指出應用的方向或可進一步研究的主題。

4.1 回顧研究目的

1. 重述研究目的時，作者所使用的時態是依導論中所採用的『導向』而定。若採用**研究導向**，在導論中使用過去式，在討論章節中也使用**過去式**。
 - This research **investigated** the effects of two different learning methods.
 - This study **attempted** to isolate the roles of tempo and loudness in affecting subject's reactions to music.
2. 重述研究目的時，若採用**論文導向**，在導論中使用現在式，在討論章節中則使用**現在完成式**。
 - This paper **has presented** a new algorithm for allocating bandwidth in networks.
 - In this paper, we **have proposed** a new technique for solving a well-known class of problems.
3. 以上二種導向的敘述都是採用主動語態，其優點是句子讀起來較有力，而且作者可以把很長的名詞子句放在動詞的後面。然而有時亦可用被動語態表達，其優點是可以強調研究主題。
 - In this study, the effects of two different learning methods **were investigated**.
 - In this paper, a new technique **has been proposed** for solving a well-known class of problems.
4. 若作者需要重述研究所使用的假設時，通常使用過去式。
 - We originally **assumed** that workers who enjoyed a greater degree of privacy **would** be more satisfied with their jobs.

- We originally **hypothesized** that successful salesmen **would** be more adept at organizing client evaluation cues.

4.2 結果概敘

1. 因為在結果章節中已對研究結果有詳細的介紹，所以在討論章節中只是對重要結果再做一次提示，以增加讀者的印象，了解要對甚麼結果進行討論。
2. 遵照結果章節中的規定，如果研究結果具有普遍的時效，則對結果的概述使用現在式；反之，如果作者認為研究結果只限於某些特殊設定條件下，則對結果的概述使用過去式。
 - All perceptual dimensions **seemed** to be influenced by the frequency response.
 - Females **reacted** adversely to louder music, whereas males **did** not.
3. 一般的研究結果都是在某些假設條件或前提之下，所獲得的，所以使用過去式較合宜。若作者非常確定研究結果具有普遍的時效，可用現在式，但此時要提防審查人或讀者嚴格的挑文章毛病。
4. 在討論研究結果是否支持原先的假設，或者是否與其他學者的結果相符時，要使用現在式，因為相符與否不受時間影響的普遍事實。
 - These test results **support** the original hypothesis that older workers would experience a decline in skills.
 - These results **are** consistent with the original hypothesis.
 - These results **appear** to refute the original hypothesis.
 - These results **contradict** the original hypothesis.
 - Our findings **are** in substantial agreement with those of Smith (1988).

4.3 對於結果的說明

1. 說明或解釋結果所使用的句子，其主要動詞通常是表示可能性的現在式動詞，後面接著以 that 開頭的名詞子句。子句中的動詞可使用現在式或過去式，依據研究結果的適用範圍而定：
 - It is possible that adding water **caused** the reaction rate to increase. (只對於本次實驗有效)
 - It is possible that adding water **causes** the reaction rate to increase. (作者認為普遍有效)
2. 作者也可將上面句型中的以 that 開頭的名詞子句改成獨立的句子，並在主要動詞前加上 may 或 could 語態助動詞：
 - Adding water **may have increased** the reaction rate. (結果只對於本次實驗有效)
 - Adding water **may increase** the reaction rate. (作者認為結果普遍有效)

3. 如果作者非常確定研究結果的適用範圍，則連語態助動詞也可省略，不過這是較不謙虛的表示方法：
 - Adding water **increased** the reaction rate. (作者確定認為結果只對於本次實驗有效)
 - Adding water **increases** the reaction rate. (作者確定認為結果普遍有效)
4. 說明結果產生的可能原因，可以使用 **may be due to**, **can be attributed to**, **may be caused by**, 等等詞句，然後將被說明的對象當主詞，要說明的內容則放在動詞後面的介係詞片語中：
 - This inconsistency **may be due to** an error in Equation (2).
 - Increases in absorption at high-doping levels **can be attributed to** dopant-induced stress.
 - The rapid decrease in the secondary electron yield **may be caused by** adsorbate sputtering followed by oxygen depletion.

4.4 推論

1. 作者根據研究結果進行推論時，應使用現在式動詞，而且通常會利用臆測動詞(appear, suggest, seem)以及語態助動詞 may。使用現在式的原因是推論不只是在討論自己特定的研究結果，而是更大範圍的有效性。

| 主要子句/現在式/ | that | 推論/現在式/ |
|--|------|--|
| Our results indicate The data reported here suggest These findings confirm It appears These results imply Our data provide evidence These findings support the hypothesis | that | the mechanism is operative in both regions. (作者使用現在式代表很確定此結論有效) The reaction rate may be determined by the amount of oxygen available. (作者比較不確定此結論是否有效) |

2. 作者也可將上面句型中的以 that 開頭的名詞子句改成獨立的句子，並在主要動詞前加上 may 語態助動詞或使用臆測動詞：
 - The mechanism **appears** to be operative in both regions.
 - The reaction rate **may be** determined by the amount of oxygen available.
3. 如果作者非常確定研究結果的適用範圍，則連語態助動詞也可省略，直接使用簡單現在式，不過這是較不謙虛的表示方法：
 - The mechanism **is** operative in both regions.
 - The reaction rate **is** determined by the amount of oxygen available.

4.5 方法或結果的限制

1. 如果是屬於數量上的限制，應該使用過去式：
 - The number of people surveyed **was** quite small.
 - Only two sets of conditions **were** tested.
2. 如果是屬於性質上的限制，應該使用現在式：

- The proposed model **neglects** several potential important parameters.
 - Our analysis **is** based on two simplifying assumptions.
 - The method presented here **is** accurate, but **cannot be implemented** in real-time applications
3. 猜測其他限制條件所可能產生的結果，應該使用現在式，並在動詞前加上助動詞 may 或 might：
 - Tests with other age groups **might yield** different results.
 - An experiment using different initial conditions **might produce** different results.
 4. 有些作者採用主詞 we 及動詞 admit 或 recognize，直接承認研究方法的限制：
 - We **recognize** that the degree of privacy is difficult to quantify.
 - We readily **admit** that a single short test may not fully reflect the subjects' level of competence.

4.6 實際應用及未來研究方向

1. 建議新的研究方向時，作者通常使用現在式動詞，並在動詞前面加上語態助動詞 would, could 或 should(比較強烈)：
 - Another interesting topic **would be** to examine how learning outcomes are related to concept attainment.
 - A further study **should be** conducted with other populations.
2. 作者表達建議時，另一種方法是採用第一人稱，並以 suggest 或 recommend 當作主要動詞，所建議的內容則以 that 子句表達：
 - We **suggest** that similar studies (should) be conducted with other languages, such as Fortran.
 - We **recommend** that these experiments (should) be repeated using a wider range of initial conditions.
3. 當作者要表達目前正在進行的相關研究時，可以使用現在進行式或未來式，而且最好用 we 當主詞，讓讀者清楚是作者自己的行為，而非建議：
 - In the future, we **will investigate** the effect of using an oxygen ambient.
 - We **are now conducting** experiments on low-temperature deposition.
 - Experiments on low-temperature deposition are now being conducted. (不清楚實驗者是誰)
4. 要指出研究的實際應用時，作者應使用現在式，並加上助動詞 may, might 或 should (用 should 時，表示作者對自己的應用非常確定)：

- The results of this study may lead to the development of effective methods for teaching grammar.
- The results of this research might help consumers to make more informed decisions.
- The technique presented here should be useful in reducing the amount of sludge in wastewater.

5. 結論(Conclusion)

5.1 結論寫些甚麼

結論是濃縮版的結果與討論，結論章節的目的是要將結果與討論章節的內容總結成簡短的幾行字，方便讀者記憶。結論的內容包含：(1) 簡略地重覆最重要的結果，(2) 指出結果的蘊涵及所衍生的推論，(3) 建議新的研究題目或實際應用的方向。

『結論』就是三言兩語說出小論文的核心，結論就像是把一本武功秘笈濃縮成幾個字的口訣，記得口訣就會聯想到整本秘笈的內容。口訣既要簡單又要包含全部，所以絕非照抄自秘笈內容的某部分。同樣的道理，結論如果既要簡又要廣，就不能沿用抄錄原結果與討論章節內的字句，而是溶化文字後，重新精煉[3]。

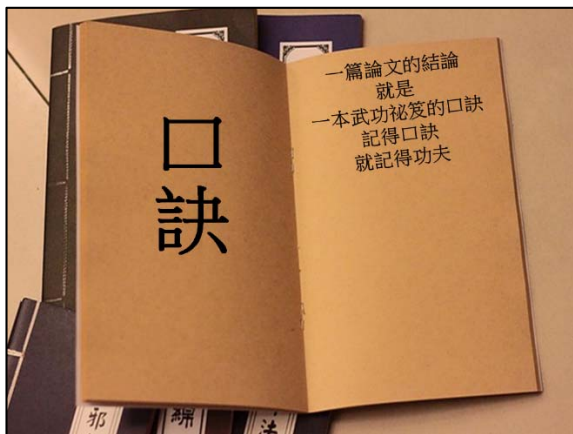


圖 5. 結論就像是把一本武功秘笈濃縮成幾個字的口訣。

5.2 結論的句型結構

1. 結論的第一個句子通常是對主要研究活動的概述。當文章採用『論文導向』時，研究活動的概述用現在完成式；當文章採用『研究導向』時，則用過去式：
 - (論文導向) This paper has presented a new method for simulating the effect of elastic scattering on angular and depth distributions of excited photo and Auger electrons..
 - (研究導向) Silicon substrates and MBE-grown silicon films doped with either Sb or In at various concentrations were studied by a time-resolved transient grating technique.
2. 在結論中重述實驗的結果時，要使用過去式：
 - Subjects given a program with moderate

indentation had higher average comprehension scores than subjects given programs with no indentation or excessive indentation.

3. 結論中之論點如果具有普遍的有效性，使用現在式；如果論點只能適用於本次實驗的結果，則用過去式：
 - (特殊有效) The elastic collisions in the specimen caused photoelectrons to originate at shallower.
 - (普遍有效) The elastic collisions in the specimen cause photoelectrons to originate at shallower.
4. 要指出進一步的研究或實際應用時，作者應使用現在式，並加上助動詞 may, might 或 should：
 - Experiments similar to those reported here should be conducted using a wider variety of materials.
 - The technique presented in this paper may be useful in reducing the amount of paper wasted.
 - We recommend that these experiments (should) be repeated using a wider range of initial conditions.

6. 摘要

6.1 摘要的內容

- 摘要濃縮版的論文，摘要儲存了論文的所有識別碼，網路搜尋引擎正是根據摘要所提供的識別資料進行相關主題搜索。
- 摘要應包含下列資料：(1)簡略地描述研究背景，(2)敘述研究目的及主要的研究活動，(3)描述研究方法，(4)概述最重要的結果，(5)簡述主要的結論或建議。
- 摘要是寫給還未看文章的人看的；結論是寫給已看過文章的人看的。前著重在吸引人，後者重在加深印象。
- 摘要是精彩畫面預告，目的是要引人注意；結論是經典畫面重播，目的是要永留記憶。二者的功能大不相同，但很多文章的摘要與結論讀起來卻是大同小異。

6.2 摘要的句型結構

1. 摘要在介紹背景資料時，如果內容不受時間影響，使用現在式，如果內容為某種研究的趨勢，則使用現在完成式：
 - (普遍事實) An important variable affecting the comprehension of programs is their psychological complexity.
 - (研究趨勢) Much research has been devoted to investigating the quenching and aging of polymers.
2. 摘要在敘述研究目的及研究活動時，當文章採用『論文導向』時，研究活動的概述用現在式；當文章採用『研究導向』時，則用過去式：
 - (論文導向) A numerical method is proposed for solving the symmetric eigenvalue problem.

- (研究導向) This study investigated the distance at which subjects prefer to work in ...
3. 摘要在描述研究方法時，如果是關於方法的數量，使用過去式；如果是關於方法的特性，則用現在式：
- (方法的數量) The visual strain of 20 subjects aged 19~51 years was estimated by means of ...
 - (方法的特性) A Monte Carlo model is used to calculate the photoelectron intensity.
4. 摘要在敘述主要結果時，如果研究結果是在特定情況下才成立，使用過去式；如果研究結果有普遍的適用性，則用現在式：
- (特殊有效) The scores of subjects who received a program written with moderate indentation were higher than the scores of the other groups.
 - (普遍有效) Workers with more privacy report a greater degree of satisfaction with their jobs.

7. 翻譯成英文

- 研究成果是產品，論文發表是包裝產品的方式之一，而寫成不同的語言，則像是選擇了不同顏色的包裝紙。好的研究成果不管用哪一種語言表達都是好。不好的研究成果縱使用英文表達也不會加分。
- 用不同顏色的包裝紙，只是為迎合不同人的喜好。用不同語言寫論文，只是方便不同國籍背景的人閱讀。包裝紙的不同不影響包裝的過程，語言的不同不影響論文寫作的過程。

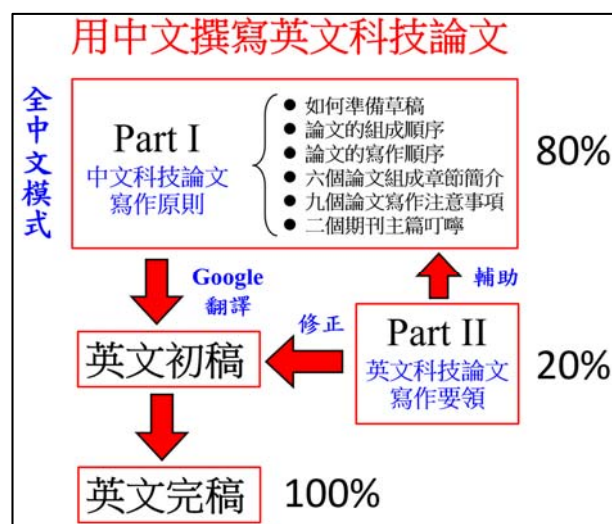
受詞、副詞等等都要明確顯示，不要忽略或含糊帶過，否則翻譯所得的英文將不合中文的原意，或不合英文文法。

4. **加入連接詞**。對於由多個句子所組成的中文複合句，句子與句子之間要有適當的連接詞，否則會被 Google 當成是獨立的句子。
5. **注意語態與時態**。中文句子中的語態(主動或被動)與時態(現在式、過去式、未來式、完成式)通常不明顯，因此 Google 翻譯後的英文自然無法呈現正確的語態與時態。

參考文獻(References)

所有引用自他人的觀點、圖表或文字內容，全部都要在參考文獻中引述出處，格式如下：

- [1] 楊憲東，中英科技論文寫作原則，國立成功大學航太系，2016 年。
- [2] 楊憲東，中英科技論文寫作要領，國立成功大學航太系，2016 年。
- [3] 方克濤，英文科技論文，全文書局，1996 年。



- 使用 Google 英文翻譯的注意事項
1. **做好斷句**。先將中文文章明確斷句，句子與句子之間用句號明確分隔。
 2. **一次只翻譯一句中文**。十句中文分十次輸入到 Google 翻譯中，分別得到十句英文翻譯。這是最保險的作法。
 3. **中文句要完整**。一個中文句子中的主詞、動詞、