STGC8003:
Research Methods and Ethics

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Course Arrangement & Assessment

Arrangement

- ***Lectures***
- ***Conducting Literature Survey***
- ***Writing Scientific Paper***
- ***Giving Oral Presentation***

Assessment

Participation:	***10%***
Report on Literature Survey:	***30%***
Scientific Paper :	***30%***
Oral Presentation:	***30%***

Course Objective and Content

Objective

- Learn the basic research skills from research methodology, research proposal to scientific paper writing;
- Create a capacity in proposing an original and impactful PhD research project through a few case studies.

Content

- ***Lecture***: Research methodology, professional ethics (倫理) and academic integrity (誠信), and paper writing techniques;
- ***Project***: (a) perform a literature survey; (b) write a formal scientific paper.

Meaning of Research (1)

- **'Re'-search** — Search again, again, and again, …;
- **Research** : **a search for knowledge; a movement from the known to the unknown; a voyage of discovery**
- **The Advanced Learner's Dictionary of Current English --** a careful ***investigation*** or inquiry specially through ***search*** for **new facts** in any branch of knowledge.
- **Redman and Mory's definition in** *The Romance of Research* **--** "systematized effort to gain **new knowledge**."
- **Inquisitiveness (好奇)** -- the mother of all knowledge; **the method,** for obtaining the knowledge of whatever **the unknown**, can be termed as "**Research**".

Meaning of Research (2)

- **'Albert Einstein's Quotations (引用句)**

  - **Never** regard your study (research) as a **duty**, **but** as an **enviable** (令人羡慕) opportunity;
  - Everything should be made **as simple as possible**, but **not any simpler**;
  - **Politics** is **for the present**, but an **equation** is something for **eternity** (永恆).

  Mass-Energy Equivalence: **$E = mc^2$**

- **Research: original** contribution to existing stock of knowledge

  - defining and redefining problems;
  - formulating hypothesis (假設) or suggested solutions;
  - collecting, organizing and evaluating data;
  - making deductions and reaching conclusions;
  - testing conclusions to determine whether to fit hypothesis.

Objectives of Research

- **Purpose:** to **discover** ***answers to questions*** or ***solutions to problems*** through the application of scientific procedures;
- **Target:** to **find out** the truth ***hidden*** or ***not discovered as yet***.
- **Objectives:**
  - To gain familiarity with a phenomenon or to achieve new insights into it; (*exploratory 探索*)
  - To portray accurately the characteristics of a particular individual, situation or a group; (*descriptive 描述*)
  - To determine the frequency with which something occurs or it is associated with something else; (*diagnostic 診斷*)
  - To test a hypothesis of a causal relationship between variables. (*hypothesis-testing*)

Motivations in Research

- Desire to face the challenge in solving the unsolved problems, i.e., concern over problems initiates research;
- Desire to get intellectual joy of doing some creative work;
- Desire to get a research degree along with its consequential benefits; (***students***);
- Desire to get respectability; (**scholar**)
- Desire to be of service to society;
- In addition, there are many other factors such as directives of government, employment conditions, curiosity about new things, desire to understand causal relationships, social thinking and awakening, and the like.

Types of Research (1)

- ***Descriptive vs. Analytical***
  - **Descriptive**: surveys and fact-finding enquiries of different kinds, including comparative and correlational methods;
  - **Analytical**: Analyzes the items or variables using facts or information already available.
- ***Applied vs. Fundamental***
  - **Applied:** aims at finding a solution for an immediate problem facing a society, an industrial/business organization; (*discover a solution for practical problem. e.g., Engineering*)
  - **Fundamental:** mainly concerned with generalizations and with the formulation of a theory. (*find information that has a broad base of applications. e.g., Science/Math*.)

Types of Research (2)

- ***Quantitative vs. Qualitative***
  - **Quantitative**: based on the measurement of quantity or amount and applicable to phenomena that can be expressed in terms of quantity;

    Note: *well implemented in Natural Science & Engineering*, e.g., why a TV can not receive the signal? Need to study quantities: transmitting power of a transmitter and gain of a receiving antenna are high enough?

  - **Qualitative**: concerned with qualitative phenomenon, i.e., phenomena relating to or involving quality or kind.

    Note: Social Science: *investigate the reasons for human behavior, e.g.,* why people think or do certain things?)

Research Approach (1)

- ***Two basic approaches***

  - **quantitative approach**: involves the generation of data in **quantitative form** which can be subjected to rigorous quantitative analysis in a formal and rigid fashion.

Its sub-classifications

(a) Inferential (推理): form a data base from which to infer characteristics or relationships of population;

(b) Experimental (實驗): much control over research environment , where some variables are manipulated to observe their effect on other variables;

(c) Simulation (模擬): construct an artificial environment within which relevant information/data can be generated.

Research Approach (2)

Simulation: refers to "the operation of a **numerical model** that represents the structure of a dynamic process. Given the values of initial conditions, parameters and exogenous variables, a simulation is run to represent the behavior of the process over time."
(Well used in various designs in many fields nowadays!)

- **Qualitative approach**: concerned with **subjective assessment** of attitudes, opinions and behavior. It generates results either in non-quantitative form or in the form which are not subjected to rigorous quantitative analysis.

  (I.E.: focus group interviews and depth interviews.)

Significance of Research (1)

- **Hudson Maxim (**US Chemist & *inventor of smokeless gunpowder* 無菸火藥**)**: "All progress is born of **inquiry**. Doubt is often better than overconfidence, for it leads to inquiry, and inquiry leads to invention".
- Research inculcates scientific/inductive thinking (灌輸科學/歸納思維); it promotes the development of logical habits of thinking /organization.
- The role of research in several fields of applied economics has greatly increased in modern times.
- Research provides the basis for nearly all government policies in our economic system.
- Research has its special significance in solving various operational/planning problems of business and industry.

Significance of Research (2)

- **In addition, the following points can be well understood**:

a) To those postgraduates, research may mean a careerism (生涯) or a way to attain a high position in the social structure;

b) To professionals in research methodology, research may mean a source of livelihood (生計);

c) To philosophers and thinkers (哲學家和思想家), research may mean the outlet for new ideas and insights;

d) To literary men and women (文學家), research may mean the development of new styles and creative work;

e) To analysts and intellectuals, research may mean the generalizations of new theories.

Research Process (1)

- **Formulating the research problem**: *understanding the problem thoroughly, rephrasing the same into meaningful terms from an analytical point of view, and formulating a general topic into a specific research problem;*
- **Extensive literature survey**: *conducted in connection with the problem through all the resources, e.g., journals, conference proceedings, reports, patents and so on (from one source to another and carefully study the earlier ones)*
- **Developing the hypothesis**: *very specific and limited to the piece of research in hand; to delimit the area of research (劃定研究領域) and to keep one on the right track; to focus attention on the more important facets of the problem.*

Research Process (2)

- **Preparing the research design**: *need to consider (i) the means of obtaining the information; (ii) the availability and skills of the researcher/staff; (iii) explanation of the selected means of obtaining information; (iv) the time available for research; (v) the cost factor relating to research;*
- **Determining sample design**: *All the items under consideration in any field of inquiry constitute a "universe"; quite often we select only a few items (sample) from the universe for our study purposes; the way of selecting a sample (sample design)*
- **Collecting the data**: *primary data can be collected either through experiment or through simulation (by observation) in the field of Science and Engineering;*

Research Process (3)

- **Execution of the project**: *If the execution of the project proceeds on correct lines, the data to be collected would be adequate and dependable;*
- **Analysis of data**: *analyze the collected data with the help of various statistical measures via editing and tabulation;*
- **Hypothesis testing**: *Do the facts support the hypotheses or they happen to be contrary?* ***Result****: either accepting the hypothesis or in rejecting it;*
- **Generalizations and interpretation**: *If a hypothesis is tested several times, it may be possible to arrive at* ***generalization****, i.e., to build a theory; If no hypothesis to start with, he might seek to explain his findings on the basis of some theory (****interpretation****);*

Research Process (4)

- **Preparation of the report of the results, i.e., formal write-up of conclusions reached:**

a) **Layout of the report**: (i) the preliminary pages (*title, date, acknowledgements, a table of content*); (ii) the main text (*introduction*, *summary of findings*, *main report and conclusion);* (iii) the end matter (*appendices and list of references or index*);

b) **Writing**: *in a concise and objective style avoiding vague expressions such as 'it seems,' 'there may be', and the like;*

c) **Charts and illustrations**: should be used only if they present the information clearly and forcibly;

d) **"confidence limits"** and **"constraints"**: must be **stated**.

Criteria of Good Research

- **Systematic:** *structured with specified steps to be taken in a specified sequence in accordance with the well defined set of rules;*
- **Logical:** *guided by the rules of logical reasoning and the logical process of induction/deduction (歸納/推導) are of great value in carrying out research;*
- **Empirical:** *related basically to one or more aspects of a real situation and deals with concrete data that provides a basis for external validity to research results;*
- **Replicable:** *allows research results to be verified by replicating the study and thereby building a sound basis for decisions.*

Thoughts on Academic Research vs Writing

- **Motivation, incentives, goals**
  - ✓ **Motivation (動機)—** Why do **research**? and why **publish**?
  - ✓ **Incentives (激勵)—** impact, name, promotion, $$
  - ✓ **Goals (目標)—** determine approach as well as outcome
  - ✓ The eventual "**bottom-line**" — **Quality** >> **Quantity**
- **Preparations**
  - ✓ **Literature review** — don't write something after which realizing it's already published
  - ✓ Read **more good papers** — before to write a good paper
  - ✓ Know **one single idea** from a top-tier journal paper
  - ✓ You should be the expert among the peers on a very topic

Academic Writing — Categories

- **Thesis** - most relevant to all of you
  - ✓ A document submitted in support of candidature for an academic degree presenting your research & findings
- **Journal & conference articles** - Important to all researchers
  - ✓ Major platforms for dissemination of new scientific knowledge and findings
- **Research proposals & reports** - relevant to your future career
  - ✓ Key exercise to obtain funding to support research
- **Books, book chapters, and monographs**
  - ✓ Summarize many works in one specific field (e.g., thesis)

Thesis Work and Writing

- **Choosing a research topic**
  - ✓ **"Great" research** is all about choosing the **"right" topic**
- **General guide in thesis work**
  - ✓ "Plan of attack" — know yourself and know your enemy
  - ✓ Plan for "battle" — go into "battle" — win "battle"
  - ✓ Managing relationship with your supervisor & co-workers
  - ✓ Team work — researching alone can be a lonely business
- **Writing thesis**
  - ✓ When? — along the way, or at the end
  - ✓ What? — answer is part of the thesis
  - ✓ How? — read more, learn as you read
  - ✓ A continuous, accumulative, and open-ended process

Choosing a Research Topic

- 孫子; **Sūn Zǐ**; (c. 6th century BC) was a Chinese General, military strategist, and author of ***The Art of War*** (孫子兵法)

  ✓ 知彼知己，百戰不殆 — If you know your enemies and know yourself, you will not be imperiled in a hundred battles

  ✓ 不知彼而知己，一勝一負 — if you do not know your enemies but do know yourself, you will win one and lose one

  ✓ 不知彼，不知己，每戰必殆 — if you do not know your enemies and yourself, you will be imperiled in every single battle

Know Yourself

- **Understand where you are and what you have**
  - ✓ Do you have the **necessary background** to complete the work?
  - ✓ Are you **willing to** put in the effort to build up the knowledge?
  - ✓ Be **realistic** about your ability and interest!
  - ✓ Although your thesis advisor plays a certain role, the responsibility rest on your shoulders!
  - ✓ Know the facilities available to you

Know Your Enemies

- **Know what is the state of the art**
  - ✓ Do a thorough review of the area that you have chosen to work in
  - ✓ Know who are the key people doing similar work — benchmark against the best
  - ✓ Look out for publications that comes from them
  - ✓ Analyze their papers
  - ✓ Try to understand ***how*** they develop new ideas
  - ✓ Know the facilities that they and their collaborators have

Plan for "Battle"

- **Plan your strategy and approach**
  - ✓ *Experimental or theoretical?*
  - ✓ Think through your methodology
  - ✓ *Skillfully design your experiments*
  - ✓ Understand limitations of the equipment
  - ✓ *Be careful in carrying out experimental work - repeat, …*
  - ✓ Critically analyze your results
  - ✓ *Compare with what others have obtained*
  - ✓ Be flexible to change direction
  - ✓ *Think outside the box*

Go into "Battle"

- **Establish your "footprint" on the world stage**
  - ✓ Keep a detailed log book and raw data of all the works you have ever done
  - ✓ *File your patent with claimed innovation or publish your results as soon as possible*
  - ✓ Choose reputable international journals in your field
  - ✓ *Cite the works of others and be sure to differentiate your work from theirs*
  - ✓ Write your report or paper concisely and clearly

Winning the "Battle"

- **Go deeply and widely**
  - ✓ Know what there is to know about your topic
  - ✓ Explore applications in other areas — you are building a research career and not just for your thesis topic
  - ✓ **Examples**: (a) *extend the antenna technology to design of RF/microwave circuits*; (b) *open up your own spin-off company from your developed technology after your graduation* (e.g., RFID, wireless power transmission,…)
  - ✓ However, do keep within a framework that is relevant to your thesis topic

Literature collection (文獻收集)

- ✓ *Electronic or E-Resources*: Available in UM Library's webpage (http://library.umac.mo/lib.html) : *Databases* & *E-Journals*
- ✓ *Useful Databases:* (1) collect as many published literatures in the specific topic/field as you can; (2) understand the original ideas from a few pioneering works, research milestones and new progress in this topic/field

a) *"Science Citation Index Expanded (SCI-EXPANDED)" or SCI: Journal papers & Some conference papers (1980's ~)*

b) *"Scopus": Journal/Conference papers (1990's ~)*

c) *"Google Scholar"* (free): recent paper/books/patents

Database: Web of Science (A1)

- **website: http://thomsonreuters.com/web-of-science/**
- **Web of Science** (from *Thomson Reuters*): Allow you to access the world's leading scholarly literature in the sciences, social sciences, arts, and humanities.
- **Citation Databases:**

- Science Citation Index Expanded (SCI-EXPANDED) --1980-now;
- Social Sciences Citation Index (SSCI) --1980-now
- Arts & Humanities Citation Index (A&HCI) --1980-now
- **Conference Proceedings Citation Index- Science (CPCI-S)** --1991-now
- Conference Proceedings Citation Index- Social Science & Humanities (CPCI-SSH) --1991-now
- Book Citation Index– Science (BKCI-S) --2005-now
- Book Citation Index– Social Sciences & Humanities (BKCI-SSH): 2005-now

Database: Web of Science (A2)

- **SCI-Expanded:** *indexes over 8,500 major journals across 150 disciplines (the most highly recognized citation index in ST!)*
- **Features**
  - Find high-impact articles and conference proceedings
  - Uncover relevant results in related fields
  - Discover emerging trends that help you pursue successful research and grant acquisition
  - Identify potential collaborators with significant citation records
  - Integrate searching, writing, and bibliography creation into one streamlined process

Database: Web of Science (A3)

- **Benefits**
  - Comprehensive/Relevant Coverage: Every journal included has met the high standards of an objective evaluation process
  - Cited Reference Searching: Track prior research and monitor current developments, see who cited your work, measure the influence of work and follow the path of today's hottest ideas
  - Easy Author Identification: Locate articles written by the same authors in a simple and single search
  - Insightful Analysis Options: Find hidden trends/patterns, gain insight into emerging fields and identify leading researchers
  - Wide-Ranging Proceedings Content: Track the influence and impact of individual proceedings papers

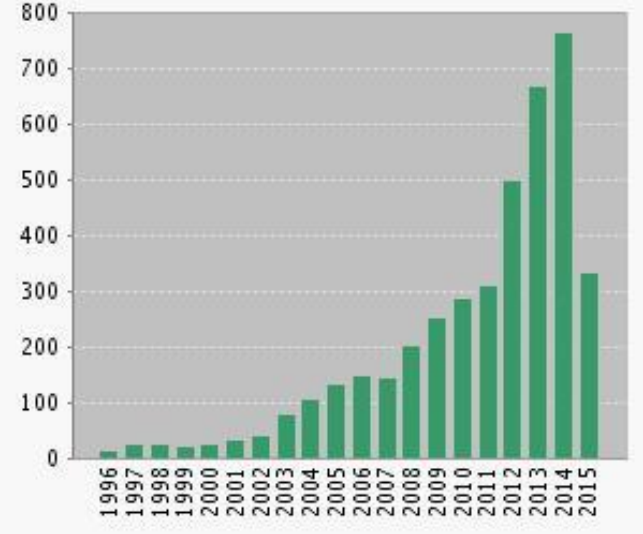
Database: Web of Science (A4)

- **Search via Web of Science**
  - **Categories**: *"**Search**"* (most useful), *"Author Search", "Cited Reference Search", "Advanced Search" and "Search History"*
  - ***Search**:*
    - *Enter "words": in "Topic", Title", "Author", "Publication Name", "Address", "Organization-Enhanced", and so on*
    - *Limits: "Timespan" (e.g., from 1980 to 2003), "Citation Databases"*
    - *(**our FST@Umac**: Click "Science Citation Index Expanded (SCI-EXPANDED) --1980-present", "Conference Proceedings Citation Index- Science (CPCI-S) --1991-present" and/or "Book Citation Index– Science (BKCI-S) --2005-present")*

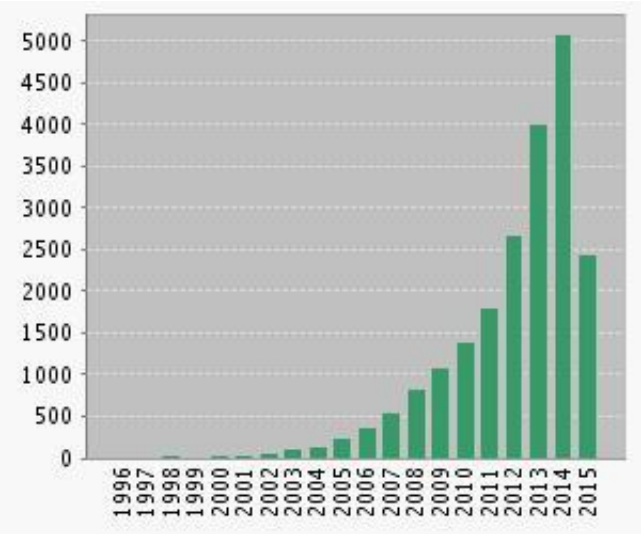
Database: Web of Science (A5)

- **Outcome of search for "University of Macau" (11-Jun-2015)**

Published Items in Each Year



Citations in Each Year

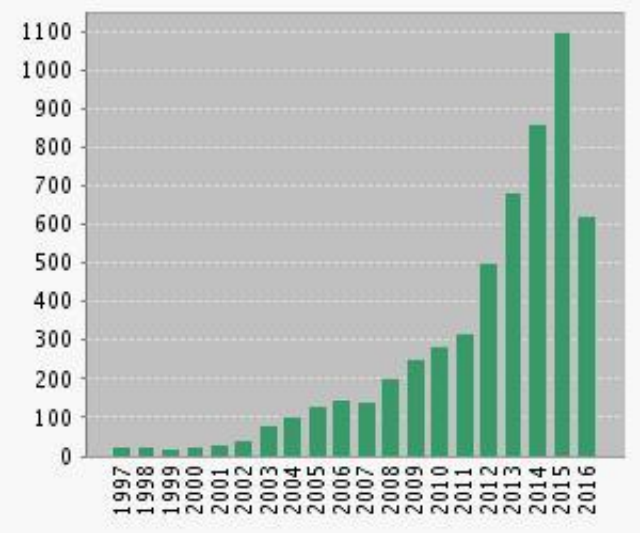


- **Results found: 4141; Sum of the Times Cited: 20963**
- **Sum of Times Cited without self-citations: 17270;**
- **Citing Articles: 16134; Citing Articles without self-citations: 14658;**
- **Average Citations per Item: 5.06; h-index : 43**

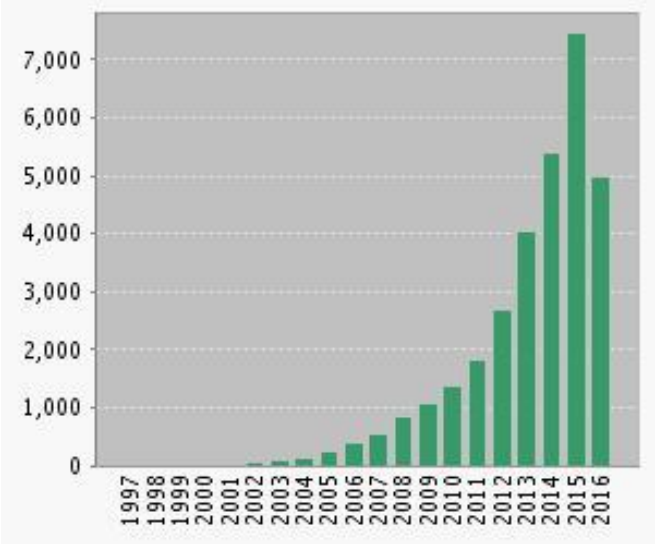
Database: Web of Science (A6)

- **Outcome of search for "University of Macau" (2-Aug-2016)**

Published Items in Each Year



Citations in Each Year



- **Results found: 5651; Sum of the Times Cited: 31354;**
- **Sum of Times Cited without self-citations: 25945;**
- **Citing Articles: 23821; Citing Articles without self-citations: 21711;**
- **Average Citations per Item: 5.55; h-index : 61**

Database: Web of Science (A7)

- **Outcome of search for "University of Macau" (15-Aug-2017)**

(2001-2017)

Database: Web of Science (A8)

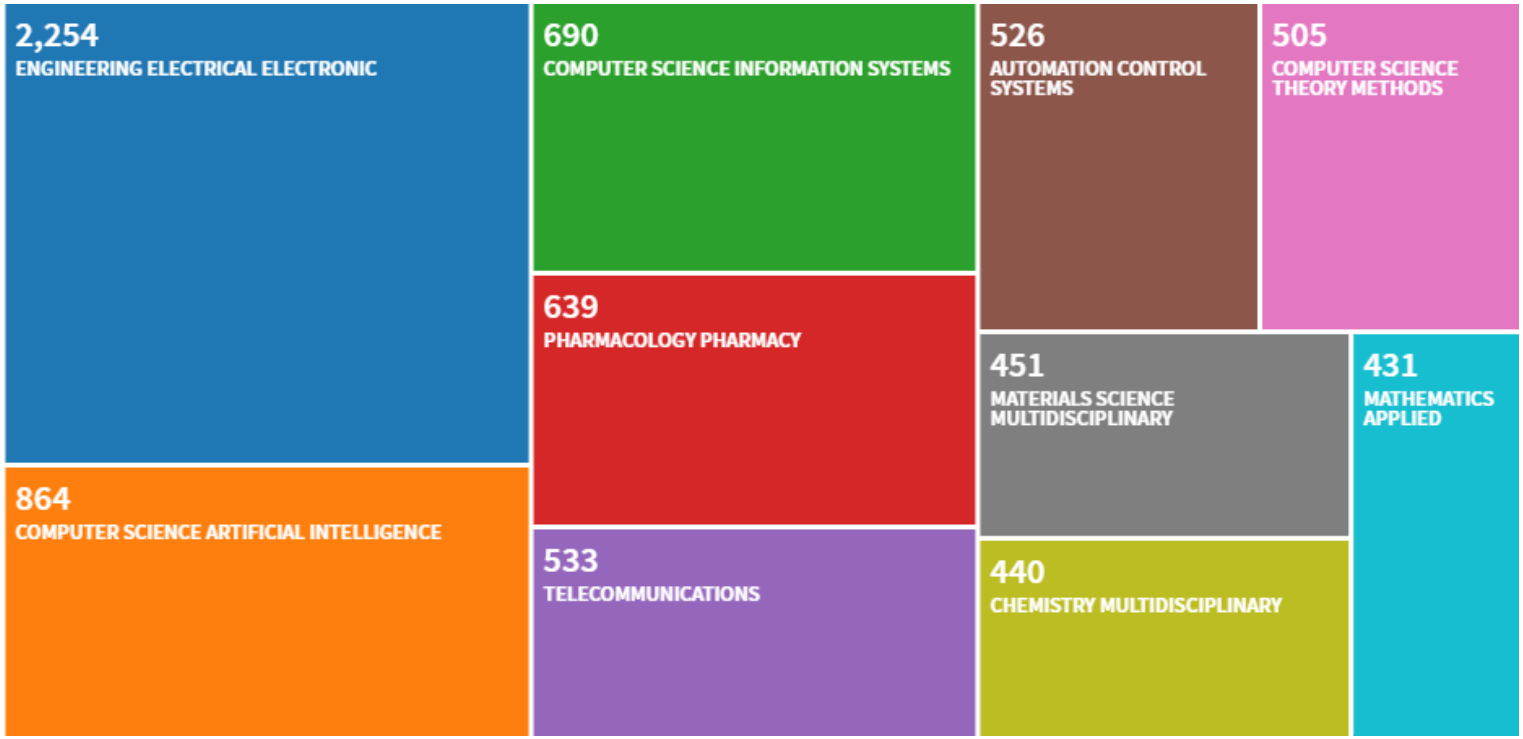
- **Outcome of search for "University of Macau" (22-Aug-2018)**

(2010-2018)

Database: Web of Science (A9)

- Outcome of search for "University of Macau" (20-Aug-2019)

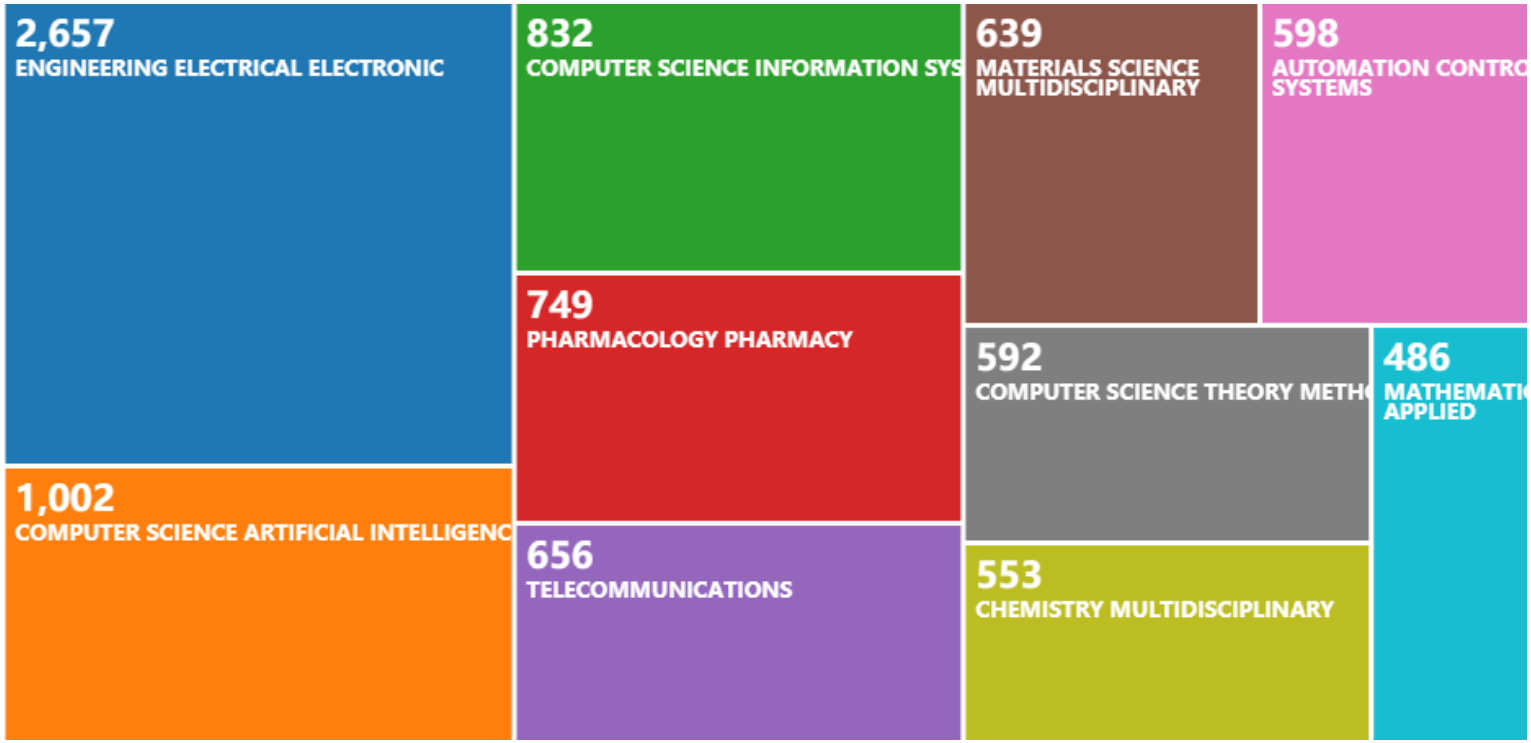
Citation Report not available for a search containing > 10,000 records



Database: Web of Science (A10)

- Outcome of search for "University of Macau" (13-Aug-2020)

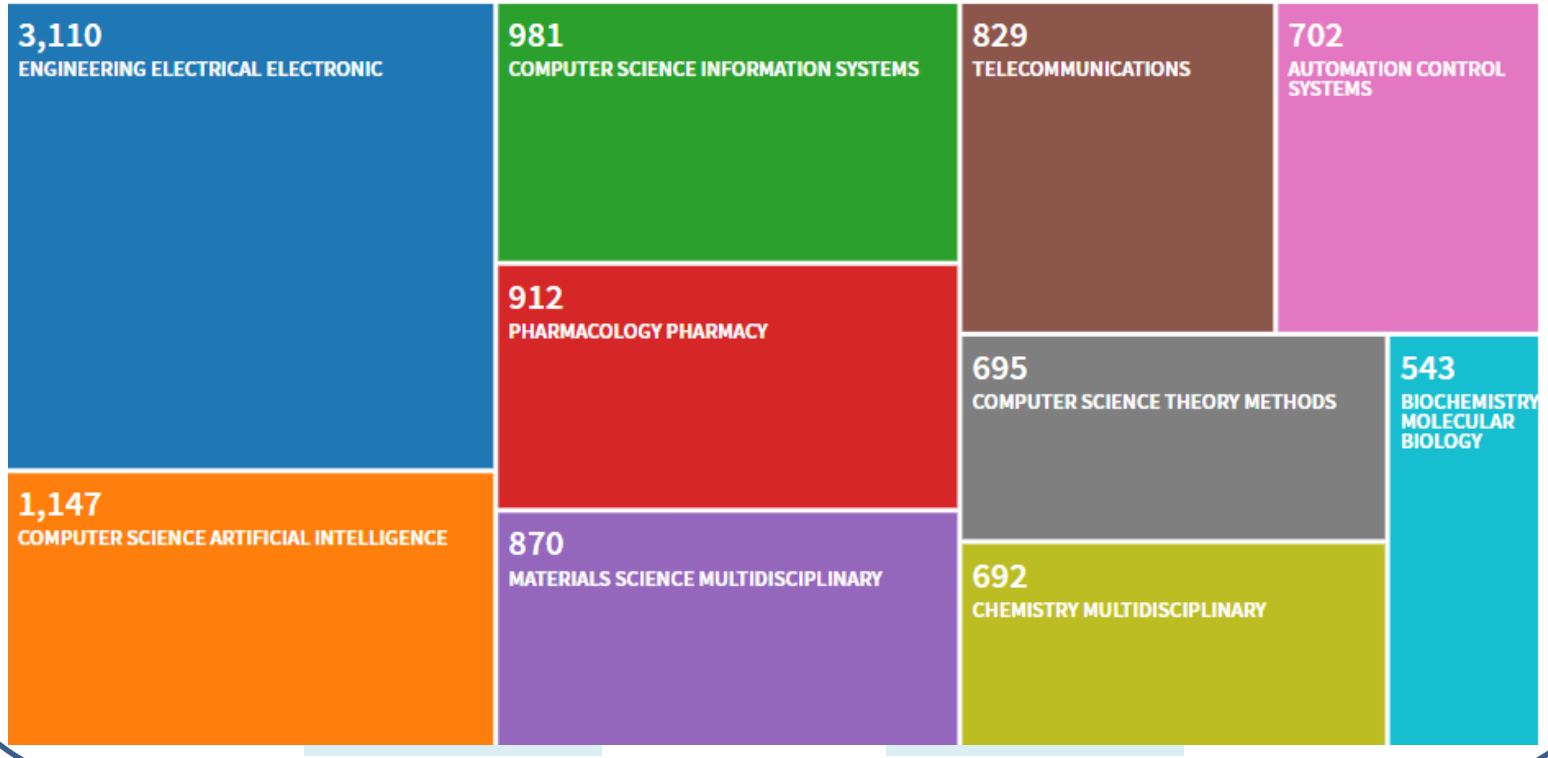
Citation Report not available for a search containing > 10,000 records



Database: Web of Science (A11)

- Outcome of search for "University of Macau" (20-Jul-2021)

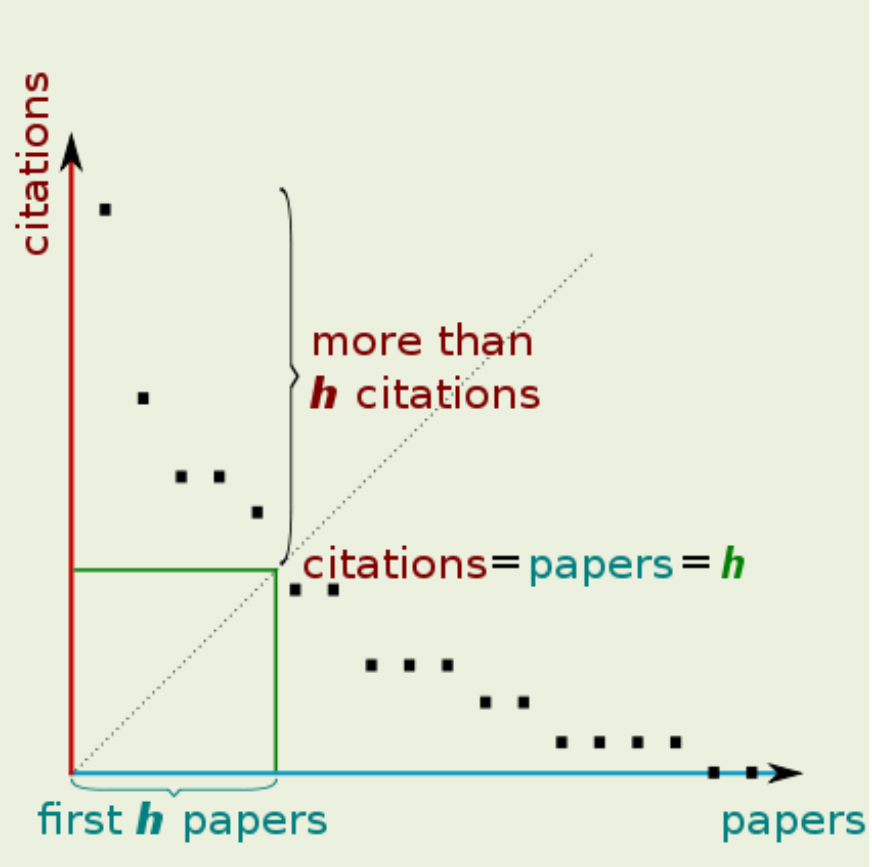
Citation Report not available for a search containing > 10,000 records



Database: Web of Science (A12)

- **H-index** (by J.E. Hirsch in 2005): a well-recognized method for evaluation of academic achievement.

- *"A scientist has index* h *if* h *of his/her* N_p *papers have at least* h *citations each, and the other* (N_p – h) *papers have no more than* h *citations each."*



Database: Web of Science (A13)

- **Impact Factor** (by Eugene Garfield, the founder of **ISI** in 1975): **average number of citations received per paper** published during the two preceding years.

- ***E.g.,*** if a journal has an impact factor of 3 in 2010, then its papers published in 2008 and 2009 received 3 citations each on average in 2010, specifically

  A = *the number of times that all items published in that journal in 2008 and 2009 were cited during 2010*

  B = *the total number of items published in 2008 and 2009*

  2010 impact factor = *A*/*B*

- ***Journal Citation Report:***
  https://jcr.clarivate.com/JCRJournalHomeAction.action

Database: Scopus (B1)

- **website: http://www.scopus.com/**
- **Scopus** (from *Elsevier in Amsterdam*): provide an alternative abstract and citation database of peer-reviewed literature.
- **Features:** smart tools to track, analyze and visualize research
  - **Search:** document, author or affiliation, and refine results by source type, year, language, author, affiliation, and so on;
  - **Discover**: Find related documents by shared references and authors; Identify/match an organization with research output;
  - **Analyze**: Track citations over time for a set of authors or documents; View h-index for specific authors; Assess trends in search results; Analyze an author's publishing output.

Database: Scopus (B2)

- **Search via Scopus**

- **Categories**: *"**Document search**"* (most useful), *"Author search", "Affiliation search" and "Advanced Search"*

- ***Document search**:*

  - ***Enter** "__": in "All fields", "Article Title, Abstract, Keywords", "Authors", "Source Title", "Article Title," "Affiliation", so on*

  - ***Limit to**: "Date Range", "Document Type" (e.g., "All", "Article", "Review", …), "Subject Areas"(i.e., "Life Sciences", "**Physical Sciences**", "Health Sciences", "Social Sciences & Humanity")*

    > Physical Sciences' Coverage: Chemistry, Computer Science, Energy, Engineering, Environmental Science, Materials Science, Mathematics, Physics (*sufficient for our FST*!)

Database: Scopus (B3)

- ***Author search**: (22-Aug-2018)*

- ***Enter*** "Last name" (e.g., "Zhu"), "Initials or First Name" (e.g., "L" and "Affiliation" (e.g., "University of Macau");
- ***Click*** "Search" → **Author Results**: **2**; *Choose* the **correct authors** based on the listed information (Authors , Subject areas, Affiliation, City and Countries)
- ***Click*** "**show documents**": **407 document results**
- ***Click*** **"view citation overview": Citations received since 1996,** incl.: Total Citations ("7471"), h-index ("45")
- **Exercise**: Search for Publications and Citations of your familiar scholar, supervisor or expert in your field!

Database: Scopus (B4)

- ***Affiliation search**: (11-Jun-2015)*

○ ***Enter*** "___" under "Affiliation" (e.g., "University of Macau")
→ **6,555** document results

○ **Analyze results**:

- "Year", "Source", "Author", "Affiliation", "Country", Document Type", "Subject Area"

- "Year": 2015 (577), **2014(1249)**, 2013(1069), …, **2003(70)**,…

-"Subject Area":

Engineering (28.9%) + Computer Science (30.4%) + Mathematics (12.5%)=**71.8%**

71.8% of all the papers under **"UM"** contributed from **FST**

Database: Scopus (B5)

- ***Affiliation search**: (2-Aug-2016)*

  - ***Enter*** "___" under "Affiliation" (e.g., "University of Macau")
    → **7,253** document results

  - **Analyze results**:

- "Year", "Source", "Author", "Affiliation", "Country", Document Type", "Subject Area"

- "Year": 2016 (926), **2015(1256)**, 2014(1015), …, **2004(119)**,…

-"Subject Area":

Engineering (30.5%) + Computer Science (29.6%) + Mathematics (12.4%)=**72.5%**

72.5% of all the papers under **"UM"** contributed from **FST**

Database: Scopus (B6)

- ***Affiliation search**: (15-Aug-2017)*

○ ***Enter*** "___" under "Affiliation" (e.g., "University of Macau")
→ **9,065** document results

○ **Analyze results**:

- "Year", "Source", "Author", "Affiliation", "Country", Document Type", "Subject Area"

- "Year": 2017 (1062), **2016(1629)**, 2015(1302), …, **2005(171)**,

-"Subject Area":

Engineering (30.2%) + Computer Science (28.6%) + Mathematics (12.6%)=**71.4%**

71.4% of all the papers under **"UM"** contributed from **FST**

Database: Scopus (B7)

- ***Affiliation search****: (22-Aug-2018)*

○ ***Enter*** "___" under "Affiliation" (e.g., "University of Macau")
→**11,022** document results

○ **Analyze results**:

- "Year", "Source", "Author", "Affiliation", "Country", Document Type", "Subject Area"

- "Year": 2018 (1215), **2017(1706)**, 2016(1607), …, **2005(171)**,

-"Subject Area":

Engineering (17.3%) + Computer Science (16.2%) + Mathematics (7.4%)=**40.9% (?)**

40.9% of all the papers under **"UM"** contributed from **FST**

Database: Scopus (B8)

- ***Affiliation search**: (20-Aug-2019)*

○ ***Enter*** "___" under "Affiliation" (e.g., "University of Macau")
→**13,458** document results

○ **Analyze results**:

- "Year", "Source", "Author", "Affiliation", "Country", Document Type", "Subject Area"

- "Year": 2019 (1439), **2018(1883)**, 2017(1727), …, **2006(171)**,

-"Subject Area":

Engineering (16.7%) + Computer Science (15.4%) + Mathematics (7.0%)=**39.1% (?)**

39.1% of all the papers under **"UM"** contributed from **FST**

Database: Scopus (B9)

- ***Affiliation search**: (13-Aug-2020)*
  - ***Enter*** "___" under "Affiliation" (e.g., "Universidade de Macau") →**15,814** document results
  - **Analyze results**:

- "Year", "Source", "Author", "Affiliation", "Country", Document Type", "Subject Area"
- "Year": 2020 (1568), **2019(2185)**, 2018(1861), …, **2013(894)**,
- "Subject Area":

  Engineering (16.4%) + Computer Science (14.7%) + Mathematics (6.7%)=**37.8% (?)**

  37.8% of all the papers under **"UM"** contributed from **FST**

Database: Scopus (B10)

- ***Affiliation search**: (20-Jul-2021)*

○ ***Enter*** "___" under "Affiliation" (e.g., "University of Macau")
→**19,938** document results

○ **Analyze results**:

- "Year", "Source", "Author", "Affiliation", "Country", Document Type", "Subject Area"

- "Year": 2021 (1808), **2020(2711)**, 2019(2385), …, **2013(965)**

-"Subject Area":

Engineering (25.0%) + Computer Science (16.3%) + Mathematics (6.4%)=**47.7% (‼)**

47.7% of all the papers under **"UM"** contributed from **FST**

Database: Google Scholar (C1)

- **Website: http://scholar.google.com/** *(a freely accessible web search engine that indexes the full text of scholarly literature across an array of publishing formats and disciplines)*
- **Main Features**
  - **Track citations to your publications:** Check who is citing your publications. Graph your citations. Compute citation metrics;
  - **View publications by colleagues**: Keep up with their work. See their citation metrics;
  - **Appear in Google Scholar search results**: Create a public profile that can appear in Google Scholar (attractive!)
  - **Collect almost all of recent publications**: Papers in journals & conferences, theses, reports, patents, documents, etc.

Database: Google Scholar (C2)

- **My Citations**
  - **Open up your own profile or webpage:** with the username and password in your Gmail account
  - **My webpage:** http://scholar.google.com/citations?user=9P7c9ZUAAAAJ&hl=en&oi=ao
  - **#1: "Search Authors" in "Macau"** http://scholar.google.com/citations?hl=en&view_op=search_authors&mauthors=Macau
  - **#2: "Search Authors" in "label:microwave_engineering"** http://scholar.google.com/citations?view_op=search_authors&hl=en&mauthors=label:microwave_engineering

Proposal for an Impactful Research (1)

- **Literature Survey (文獻調查)**
  - ✓ **Literature collection (文獻收集):** from all the available resources if a research field has been selected/assigned
  - ✓ **Intensive reading (精讀):** only a few (2-5) representative papers to study initial motivation & basic methodologies
  - ✓ **Extensive reading (泛讀):** all of the remaining papers to get a global view on history & latest achievement
  - ✓ **Topic decision (課題確認):** Target one or two unsolved problems in principle/theory and work out your own (unavailable\unreported) solutions/methods for them.

Proposal for an Impactful Research (2)

- **Literature Survey:**

✓ **Enter topic's words**: from general to specific terminology to gradually approach your specified research topic.

Example*: your research topic selected in design of* ***planar*** **(b)** ***antennas*** **(a)** *for* ***RFID*** **(c)** *application. (15-Jun-2015)*

SCI*:* ***paper no****.:* (a) **146,823**; (a)+(b) **8,934**; (a)+(b)+(c) **240**

- Sort by: "Time Cited – Highest to lowest" (**most highly cited**)

1. Title: **Planar inverted-F antenna for radio frequency identification**
Author(s): Hirvonen, M; Pursula, P; Jaakkola, K; et al.
Source: ELECTRONICS LETTERS Volume: **40** Issue: **14** Pages: **848-850** DOI: **10.1049/el:20045156** Published: **JUL 8 2004**
Times Cited: **95** (from Web of Science)

Proposal for an Impactful Research (3)

Scopus: *choose Search ____ in Article Title, Abstract, Keywords under the category of Physical Sciences*

paper no.: (a) **220,967**; (a)+(b) **13,228**; (a)+(b)+(c) **361**

- **Sort by "**cited by" (**most highly cited paper**: ***most popular work & one of most impactful works***

	Document title	Author(s)	Date	Source title	Cited by
1.	Planar inverted-F antenna for radio frequency identification	Hirvonen, M., Pursula, Jaakkola, K., Laukkanen, K	2004	Electronics Letters 40 (14) , pp. 848-850	135

- **Sort by "**Date (Newest)" (**newest published paper: from its references, one can trace back to all the previous works**)

	Document title	Author(s)	Date	Source title	Cited by
1.	A broadband and electrically small planar monopole employing metamaterial transmission line	Liu, L.-Y., Wang, B.-Z.	2015	IEEE Antennas and Wireless Propagation Letters 14, pp. 1018-1021	0

Proposal for an Impactful Research (4)

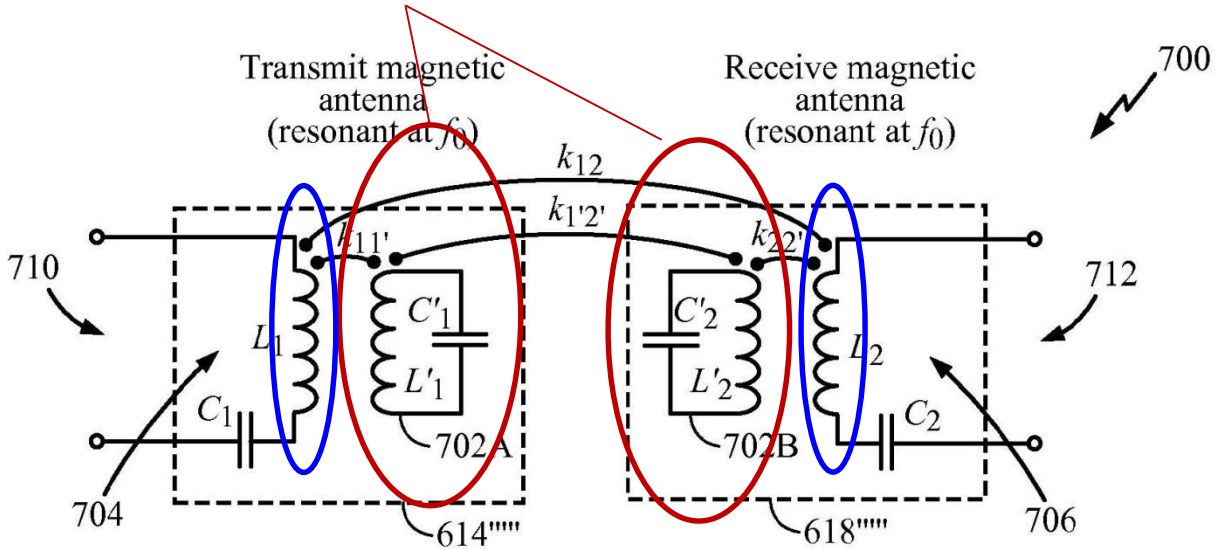
- **Research Procedure (研究步驟)**
  - ✓ **Initial ideas/methods (提出最初方案):** Intuitively and physically affirm their feasibility with your knowledge
  - ✓ **Qualitative confirmation (定性確認方案):** Using approximate but effective theory (e.g., **circuit model**) for a complex problem or accurate but time-consuming method (e.g., **fullwave model**) for a simple problem
  - ✓ **Quantitative validation (定量確定方案):** Using accurate but time-consuming method for a simple real-time problem (e.g., **1st-order filter**) to validate initial prediction
  - ✓ **Application to various problems (應用於各種實際問題):** Real problem (e.g., **high-order filter**). (**Attention**: it is the last stage only if the above stages are accomplished!)

Proposal for an Impactful Research (5)

- **What is an original and impactful research? – one example "Wireless Power Transfer via magnetic resonance coupling"**

✓ **Conventional: Purely magnetic coupling between two coils**

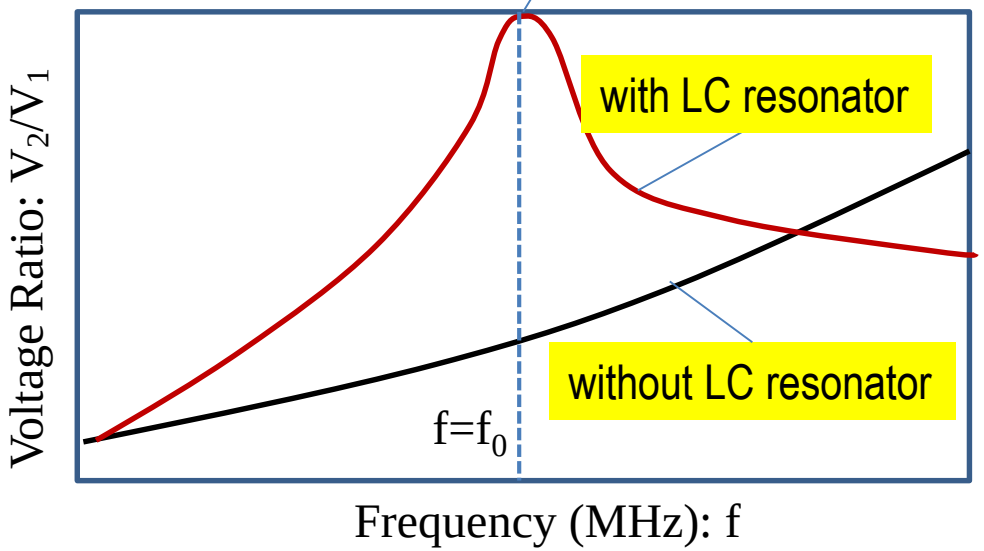
✓ **Proposed [*]: *LC resonators* in proximity to source/load coils**



[*] Kurs, Karalis, etal., "Wireless power transfer via strongly coupled magnetic resonances, " **SCIENCE**,pp.83-86, JUL 2007

Proposal for an Impactful Research (6)

✓ **Novelty**: **Transmission peak** (extremely increased level)



✓ **"New Energy":** Witricity or Wireless Electricity

[#1] Demo: http://www.youtube.com/watch?v=2ODW-ntPHSU

[#2] Charging: http://www.youtube.com/watch?v=v6W7WfcXQTQ

Example: *Literature Survey*

- **Choose One Specific Topic: Wireless Power Transfer (WPT) for application: (a) Electric Vehicles; (b) Biomedical Implants**
  - ✓ Collect all the **relevant literatures** in one of specific topics;
  - ✓ Understand the fundamental/improved **theory** and **milestones** in the research field of WPT ;
  - ✓ Study **when**, **why** and **how** this WPT has been employed for the specific application, and figure out **what** is its main ***advantages*** against other **non-WPT** techniques;
  - ✓ Find out what are unsolved **problems** or **difficulties** in the reported literatures (*from theory to implementation*);
  - ✓ Brief discussion on the proposal of a **new** or **improved** approach to solve some of them from your expertise.

Project 1: *Literature Survey*

Assignment

- **Write up a report as outcome of your literature survey: -**
  Content: Based on your current research topic;
  - Report: Length up to 5 pages & Memory up to 2 MB;
  - Email its PDF to me at leizhu@um.edu.mo by 18-Mar-2022;
- **Prepare for** a set of your own PPT slides used for oral presentation (**up to 8 pages**);
- **Present your own work** in front of your peers (**up to 10 minutes**, incl. *presentation* and *question/answer* sessions

Writing Thesis (1)

- **Abstract** — **a short summary of the thesis**
  - ✓ Need to convey a complete synopsis of the thesis, highlighting the key results – be concise
- **Introduction** — **current theories and hypothesis**
  - ✓ Provide strong statement of motivation
  - ✓ Literature review must be comprehensive
  - ✓ State the "research gap"
  - ✓ Explain how your research fills this gap
  - ✓ A list of your own major contributions
  - ✓ A brief outline of the chapters

Writing Thesis (2)

- **Theory** — **principle theory of the hypothesis**

✓ Review the theory of the hypothesis in a simple language

- **Methods** — **describe the methods used**

✓ Give an accurate description of the equipment and techniques used for gathering the data

✓ State limitations of them and how they will affect your data

- **Results** — **present the results obtained, incl. error sources**

✓ Present your findings without trying to interpret or evaluate them, other than to provide a link to the discussion section

✓ Present data graphically; and present only the key data and state the trend

✓ Put other details of data in Appendix

Writing Thesis (3)

- **Discussion — how the results do support your hypothesis**

✓ Critical part of your thesis where you start the process of explaining any links and correlations apparent in your data

✓ Criticize the experiment, and be honest about whether your data was good enough. If not, suggest any modification and improvement that could be made to the design

✓ Explain how your data support the hypothesis that you have stated in the Introduction

- **Conclusion — summarize key result to fit into "big picture"**

✓ Sum up the thesis by giving a very brief description of the results (not repeating)

✓ Anybody reading the conclusion has read the entire thesis, so the conclusion acts as an aid to memory

Writing Thesis (4)

- **References** — **provide comprehensive citation**

✓ Your bibliography must include all of the direct sources that you referred to in the body of the thesis

✓ It must include all the key papers written in your field of study up to that point in time

✓ A separate list of publications by you as a first/contributing author

- **Appendix** — **additional information that may be useful**

✓ Detailed results can be included here

✓ Lengthy equation derivations or programming codes, etc.

Journal & Conference Articles (1)

- **Differences**

✓ Journal articles for archival (mainly full papers)

✓ Conferences mainly for exchange with the peers (meet the people)

✓ Conferences for quick dissemination of results, although some journal letters also have very fast turn-around

✓ Some top-tier conferences can be more difficult to get accepted than journals

- **Common style**

✓ They both share similar style and requirements for scientific documentation

Journal & Conference Articles (2)

- **Some guides**

✓ Know the top journals/conferences in your field (e.g., **Journals**: "Science" and "Nature" (Highest -tier journals), Physical Review Letters and Applied Physical Letters (Physics), IEEE Transactions/Letters (Electrical/Electronics), …; **Conferences**: IEEE International Solid-State Circuits Conference (ISSCC) (IC Chip), …

✓ Know the "value" of your work and plan for submission to journal/conference accordingly

✓ Try higher-tier ones before lower-tier ones (more impactful to the peers/readers in the relevant fields)

✓ Turn-around time is an important consideration

Writing Journal Articles (1)

- **Title**

✓ Concise and descriptive reflection of the key contents

- **Authors and affiliations**

✓ "Rule of thumb" on co-authorship …

✓ Affiliations — acknowledging support

- **Abstract**

✓ Not just a summary, nor conclusion

✓ After reading, one would know *what the paper is about* and *its key points* without looking through the paper

- **Keywords (optional)**

✓ Very often, already contained in the title

✓ Standard ones vs. user defined ones

Writing Journal Articles (2)

- **Introduction**

✓ Concise review of important and relevant literatures

✓ Motivation of the work and its significance (important?)

✓ Inform the reader about the rationale behind the work, justifying ***why*** your work is essential in the field

- **Main body — theory, experiment, etc.**

✓ Describe the work in a logical manner, with important details within the page limit (a trade-off)

✓ Give a completely accurate description of the equipment and the techniques used for gathering the data

✓ Leave detailed equation derivations in the Appendix so as not to distract flow of ideas

Writing Journal Articles (3)

- **Results and discussion** — **critical component**

✓ Usually outside the theory/experiment description

✓ Narrate your findings without trying to interpret or evaluate them, other than to provide a link to the discussion

✓ Start the process of explaining any links and correlations apparent in your data

✓ Criticize the experiment, and be honest about whether your data was good enough. If not, suggest any modification and improvement that could be made to the design

Writing Journal Articles (4)

- **Conclusions**

✓ Not repeating abstract, nor just a mere summary of what has been presented

✓ Emphasize the key results and their significance/impact

✓ To an expert, he/she should know the value/significance of the work just by reading through the conclusions

- **Appendix (optional)**

✓ Supplement for lengthy equation derivations, etc.

- **Acknowledgment**

✓ Funding source(s) need to be credited

✓ Specific author(s) acknowledging specific people for specific contributions/assistance

Writing Journal Articles (5)

- **References**

✓ Very important: not too many/few, but relevant /accurate

✓ *Just by looking through the reference list*, an expert know if the authors are knowledgeable and the work is up-to-day

- **Some specific experiences to share**

✓ Collect all the important/relevant references before writing

✓ Be careful in making claims (e.g., the "first" …)

✓ *Work on the figures first* — before texts and descriptions

✓ Sufficient details in the figure to convey the message "at-one-glance" with concise description in the caption

✓ Abstract/Conclusions/References are the most important — what an editor/reviewer would glance through first

My Thoughts in Paper Preparation (1)

- **Figures & Tables (圖表)**

✓ **Sketch layouts/results:** in order to graphically describe original idea, numerically demonstrate attractive performances and evident validation of the predictions;

✓ **Redrawing:** select those impressive figures/tables to match with your theme and use one graphical tool (e.g., CorelDraw) to work out high-resolution figures/tables;

✓ **Outcome:** with these sequentially-arranged figures/tables, the structure/content of this article is almost established.

Note: *Most of reviewers are very busy and they usually spend a few minutes at first to observe these figures/tables – to get an initial impression on a manuscript*

My Thoughts in Paper Preparation (2)

- **List of References (參考文獻)**

✓ **Criteria in selection:** proposed original ideas even with poor results, widely-recognized works with improved performances, works reflecting milestones in this topic;

✓ **Summarize these works:** print out them and underline one or two advantages and disadvantages for each paper;

✓ **Outcome:** allow the editors to easily find qualified experts to review your paper and show the reviewers that you are an expert who is really familiar with this research topic.

Note: *If you miss a few important papers in the topic, the reviewers especially who are the authors of them will tend to reject your manuscript immediately*

My Thoughts in Paper Preparation (3)

- **Title, Abstract and Key Words (題目,摘要和關鍵詞)**
  - ✓ **Title:** Reflect your core contribution (as short as can);
  - ✓ **Abstract:** Concisely describe your methodology & results;
  - ✓ **Key words**: 3 to 5 technical words relevant to your work.
- **Introduction Chapter (引言章節)**
  - ✓ **Background:** brief the importance of this research;
  - ✓ **Motivate (Problem Finding):** praise technical success while pointing out problems for each of listed references;
  - ✓ **Objective (Problem Solving):** propose a novel/improved methodology followed by implementation and validation.

My Thoughts in Paper Preparation (4)

- **Main Body (文章主體)**
  - ✓ **Methodology:** intensively describe its procedure with virtue to schematic layout or mathematical equations;
  - ✓ **Initial confirmation:** apply the proposed methodology to a simplified problem or structure with clear qualitative answer (*e.g., 1st-order BPF or single antenna*);
  - ✓ **Numerical results:** extend it to characterize or design more practical problems or structures (*e.g., high-order BPF or antenna array*) to show its advantageous features;
  - ✓ **Evident validation:** carry out an experiment on the fabricated structure (circuits/antennas) or a comparison to those from others or EM Solvers (numerical method).

My Thoughts in Paper Preparation (5)

- **Paper Submission (論文投稿)**

✓ **<u>Before submission:</u> check your manuscript again, again, …**

a) **1st-round**: technically & logically prepared?
b) **2nd-round**: equations/figures/tables correct?
c) **3rd-round**: font and size of all the words consistent?
d) **4th-round**: References matched to specified format?
e) **… to final round**: **do you best to minimize or avoid errors/typos** to increase the rate of acceptance.

✓ **<u>Required files/documents for submission</u>**

a) Manuscript inclusive of all the figures/tables (PDF);
b) Author Check List, Copyright Form and so on.

My Thoughts in Paper Preparation (6)

- **Review Procedure:** (*a few months to one or two years!*)

✓ **Number of Reviewers** (*varied for different journals*)
IEEE Transactions (**T-MTT**): **2~8** ; **IEEE Letters** (**MWCL**): **2~8**

✓ **Decision from the Editor (1st round): (T-MTT & MWCL)**

+ **Acceptance without revision: <5%**
- **Rejection without revision: >40%**
± **Acceptance with major/minor revision: 30~60%**

✓ **Final Decision:** Primarily depend on whether your revision on the manuscript and your reply on the comments can fully or satisfactorily ***convince*** the editor and reviewers the importance of your work!!!

My Thoughts in Paper Preparation (7)

- **Key Points in Your Reply**

✓ Must understand **exact meaning** of all the comments;

✓ Must reply those comments **technically not emotionally** even you totally disagree with some of comments;

✓ Must try to revise your manuscript to include all the **instructive comments** even it is a time-consuming task;

✓ Apply well-recognized theory/principle and data/results to **defend yourself** if you disagree with one comment;

✓ Prepare for **a list of changes** made in your revised one;

✓ Target of your revision: correct all of minor errors, typos and so on, and clarify almost all of comments raised.

Writing Conference Papers (1)

- **Styles and requirements**

✓ Different from one to another — from "top-tier" (even more competitive than many journals and only a few percentages of papers accepted) to "locals" (almost given acceptance, i.e., > 90%)

✓ Different page limits and formats

- **Common requirements for abstract review**

✓ The purpose of the work

✓ The manner and degree to which it advances the art

✓ Specific new results that have been obtained and their significance

Writing Conference Papers (2)

- **Full conference paper and subsequent journal submission**

✓ Similar to journal paper styles within the given page limit

✓ Plan accordingly if you wish to submit a "more complete" journal paper with "enhanced" contents after conference

✓ Call for papers in Special Issues (in core journals of IEEE Professional society supporting this conference, e.g., IEEE MTT-S IMS Special Issue in each December): to which you may submit your extended manuscript with full length

Writing Research Proposals/Reports (1)

- **Some general thoughts**

✓ Different environment and requirements

✓ Different types of grants — large programs and competitive investigator-led research

- **Some general guide to proposal writing**

✓ Panel members reading the proposal are not specialists in your area of research

✓ Articulate clearly the state of the art

✓ State your hypothesis clearly (research gap)

✓ State your comparative advantage over other groups doing the same work

Writing Research Proposals/Reports (2)

- ✓ Show preliminary results to support your proposal
- ✓ Describe clearly the methodology
- ✓ Justify budget requested
- ✓ Write in simple "layman" language

- **Research report writing**

- ✓ Deliverable report (with specific format from funding agencies)
- ✓ Usually very brief (bullets) on key results — less is more; supported by publications

Conference Presentation (1)

- **Plan the Presentation**

✓ Assess the audience: What your audience know about the subject? What background you have to include?

✓ What do you want the audience to learn?

✓ The time available for the presentation

✓ How do I present my talk such that the audience will understand and remember what I have to say

  – ***Identify*** *the main points and scientific questions you want to address*

  – ***Develop*** *answers and* ***explain*** *the approach to solve these questions*

Conference Presentation (2)

- **Structure of the Presentation**

✓ **General Introduction**:
- *Goals, aims, motivation*
- *Compare your research to that in the literature*
- *What is novel about your research*

✓ **Methods, Results, Discussion**:
- *Select results and order them*
- *Make smooth transitions between major points*
- *Experimental approach, major findings and significance*

✓ **Conclusion and Future Work**:
- *Don't have many points*
- *Connect your results with the overview statement*

Conference Presentation (3)

- **Giving the Presentation**

✓ **Opening and Introduction**:
- *Greet the audience and introduce yourself*
- *Give the big picture (全局)*
- *Introduce the take-home message (重點總結)*

✓ **Body**:
- *Present in a Logical not chronological order*
- *Make a transition between the introduction and body*
- *Aim/Subject - Experimental approach - Results/explanation*

✓ **Conclude your presentation**:
- *Summarize the significance of your work in that context*
- *Have only a few concluding statements*

Project 2: *Write a Scientific Paper*

- **A Conference Paper (3 pages):** Prepared based on your previous research work from your **MSc/MEng project** or **final-year project** (only for those PhD students with a Bachelor's degree at highest)

  - Email its PDF to me at leizhu@um.edu.mo by 22-Apr-2022

- **Manuscript Templates for Conference Proceedings: available from IEEE webpage (Microsoft Word 2003: A4)**
  http://www.ieee.org/conferences_events/conferences/publishing/templates.html

Thoughts on Professional Ethics (職業道德)

- **Importance — being a good (honest) researcher is equally, if not more, important than doing good research**

✓ Purpose of research, life, …

✓ It is about **integrity (诚实)**— adherence to moral and ethical principles; soundness of moral character; honesty

- **Education — knowing what is "good" and "bad"**

✓ U.S. universities — "**honor system**"

✓ Being educated from young

✓ Ethics (moral philosophy), values, society norm (社會規範)

- **Scope and "rules"**

✓ Research integrity (good practices)

✓ Research misconduct — forms, reasons

✓ Publications — plagiarism, authorship, peer review, etc.

Honor System

- **Definition** — *a philosophical way of running a variety of endeavors based on trust, honor, and honesty. Something that operates under the rule of "honor system" is something that does not have strictly enforced rules governing its principles*

✓ The first honor system in America was penned at the College of William and Mary; Washington and Lee University maintains an Honor System that was introduced by General Robert E. Lee, who stated "**We have but one rule here, and it is that every student must be a gentleman**."

- **Honor code** — *a set of rules or principles governing a community based on a set of rules or ideals that define what constitutes honorable behavior within that community*

✓ Students are asked to sign an honor code statement that says they will not cheat or use unauthorized resources (the test)

Research Integrity

- **Good research practice and conduct**

✓ **Intellectual honesty**: propose, perform and report research

✓ **Accuracy**: represent contributions to proposals and reports

✓ **Fairness**: in peer review

✓ **Scientific interactions**: among colleagues, including communications and sharing of resources

✓ **Transparency**: in (potential) conflicts of interest

✓ Protection of human subjects in the conduct of research

✓ Humane care of animals in the conduct of research

✓ Adherence to the mutual responsibilities between investigators and participants

Research Misconduct (1)

- **Forms of misconduct**

✓ **Fabrication** — publication of deliberately false or misleading research

✓ **Plagiarism** — near-verbatim copying without acknowledging the source, which can also represent a violation of copyright law

✓ **Ghostwriting** — someone other than the named author(s) makes a major contribution

✓ **Honorary authorship** — conferring authorship on those that have not made any substantial contributions to the research

Research Misconduct (2)

- **Reasons for misconduct**

✓ Easiness of analysis in mathematics

✓ Easiness of fabrication in implementation

✓ Career pressure (*graduation, job-hunting, promotion,* …)

✓ Laziness

- **Clarification**

✓ Research misconduct does not include honest error or differences of opinion

✓ Research misconduct does not include disputes over authorship or credit

Research Misconduct (3)

- **Individual cases**

✓ **China**: H. Zhong, T. Liu, and their co-workers at Jinggangshan University (井岡山大學) have *retracted numerous papers* in *Acta Crystallographica* (晶體學報) following systematic checking which revealed that the organic structures claimed in these papers were impossible or implausible.

✓ **German**: Jan Hendrik Schön (physicist born in 1970's) apparent breakthroughs with semiconductors were later discovered to be fraudulent (欺詐); ***No research group in the world succeeded in reproducing the results claimed by Schön***; On Oct. 31, 2002, ***Science*** withdrew *eight papers* by Schön: On March 5, 2003, ***Nature*** withdrew *seven papers* by Schön

Self-Plagiarism (1)

- **Self-plagiarism — *reuse* *of significant, identical, or nearly identical portions of one's own work deliberately without acknowledging that one is doing so or without citing the original work***

  - ✓ The phrase is used to refer to specific forms of potentially unethical publication
  - ✓ The case of a student who resubmits "the same essay for credit in two different courses"
  - ✓ Self-plagiarism involves *dishonesty* but not intellectual theft

Self-Plagiarism (2)

- **Factors that justify reuse**
  - ✓ *The previous work needs to be restated in order to lay the groundwork for a new contribution in the second work*
  - ✓ Portions of the previous work must be repeated in order to deal with new evidence or arguments
  - ✓ *The audience for each work is so different that publishing the same work in different places was necessary to get the message out*
  - ✓ The author thinks they said it so well the first time that it makes no sense to say it differently a second time

What to Do to Prevent/Avoid "Misconduct"

- **By reinforcement? —** "**Turnitin**" (software's name)
  - ✓ Originality vs. similarity
  - ✓ Copying other's original ideas in one's own words
- **By being an honest person** — **Credibility**
  - ✓ You are the one who should know whether it is original
  - ✓ Always write in your own words
  - ✓ Always cite references where they are due
  - ✓ ***Knowing what is right and wrong***