



从“兔子理论”到“三重境界”

电子工程系 戴凌龙

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清华大学



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提纲

1 研究生角色转换的“兔子理论”

2 研究生科研工作的“三重境界”

华罗庚之“兔子理论”

- 导师和研究生的关系是“指兔子”和“打兔子”的关系

- 老师“指兔子”
- 学生“打兔子”



- “兔子理论”的扩展：研究生角色转换

- **本科生**：捡死兔子
 - 别人已经发现、并经过了反复验证的固定的知识
- **硕士生**：打活兔子
 - 还没有解决的问题、还没有被反复确认的知识
- **博士生**：找活兔子
 - 树林里值得打的活兔子

提纲

1 研究生角色转换的“兔子理论”

2 研究生科研工作的“三重境界”

王国维之“三种境界”

● 古今之成大事业、大学问者，必经过三种之境界

- **第一境：**“昨夜西风凋碧树，独上高楼，望尽天涯路”
(登高望远，了解学科概貌，明确目标与方向)
- **第二境：**“衣带渐宽终不悔，为伊消得人憔悴”
(废寝忘食、孜孜以求，奋力拼搏，追求卓越)
- **第三境：**“众里寻他千百度，蓦然回首，那人却在灯火阑珊处”
(下足功夫，自然豁然开朗，水到渠成)

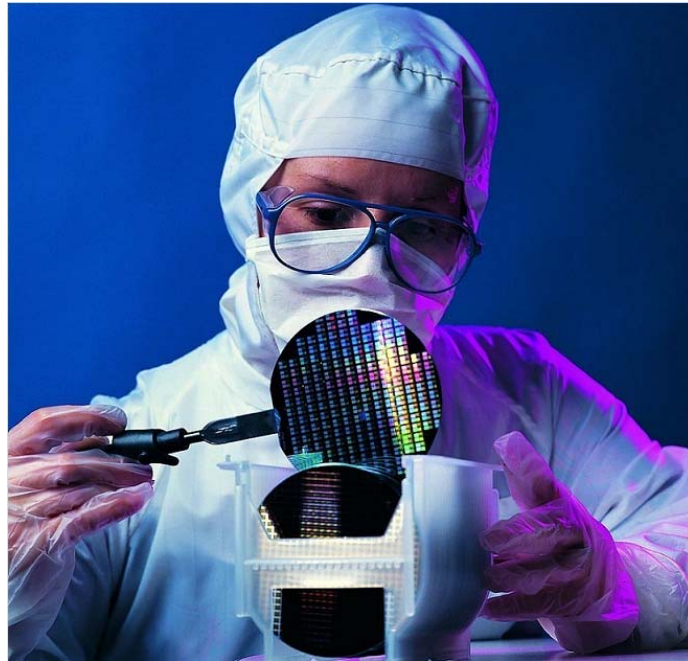


第一境：明确研究方向和目标



首要问题：什么是研究

Search → **Research**



第一境：明确研究方向和目标

● 什么样的研究才是好的研究

- 有影响力（美国加州大学伯克利分校的第一研究目标）
 - 集思广益
 - 广泛交流
 - 从实际问题和应用中获得灵感
- 科学性
 - 理论创新和科学价值
（美国博士学位证书）
- 挑战性
- 实用性



美国哈佛大学博士学位证书（拉丁文）：恭喜你
对人类的知识有所创新，因此授予你这个学位

第二境：艰苦卓绝的努力

● “一万小时定律”

- 菲尔普斯：每天训练八小时，全年无休
- 刘翔：7岁开始至今已苦练了21年



如果我们没有成功



功夫下得够吗？



“一万小时定律”：人们眼中的天才之所以卓越非凡，并非天资超人一等，而是付出了持续不断的努力。只要经过1万小时的锤炼，任何人都能从平凡变成超凡！

扎实的数理和外语基础

● “行走江湖”的必备良药：数学和英语

– 英语

- 文献、写作
- 特别注重听力和口语
 - 国际会议一撇

– 数学

- “镇宅之宝”
- 陈巍：“**一片漆黑**”（矩阵、向量表示的复杂公式）
- 数学课：随机过程、泛函分析、矩阵分析、最优化、数值分析

正确的科研方法

● 如何寻求有价值的研究课题

– 中文硕士（博士）论文：

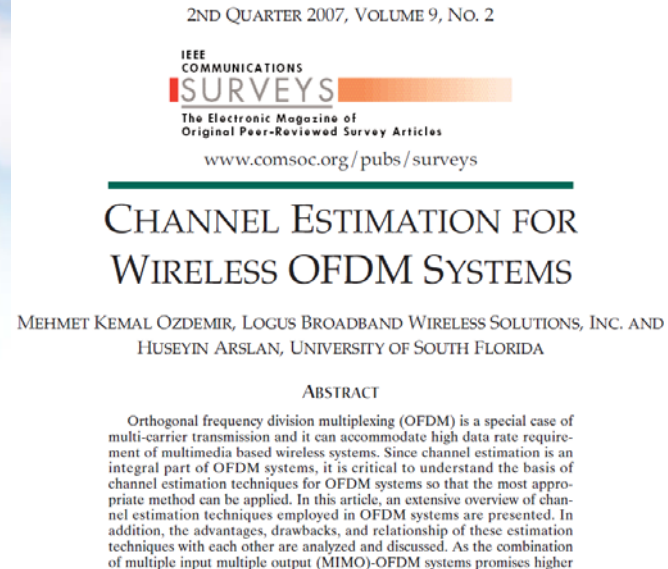
- 中国知网，5-10篇
- 扫盲、打基础

– 权威期刊上的综述性英文论文

- Proceeding of IEEE
- IEEE Signal Processing Magazine
- IEEE Communications Survey & Tutorials

– 精读阶段性成果的代表性论文

- 带着问题去读
- 舍得：先舍后得，看题目、摘要和 Introduction
- 开始避免学术味太浓的文章



“问题”是科学研究的心脏！

实验、仿真验证

● 试验方法和专业工具软件

- “工欲善其事，必先利其器”
- 仿真、实验、编程能力是重要的科研基础
 - 计算机系博士不会编程
- “摸着石头过河”：边实践边学习

实验结果的（理论）分析

● 性能分析

- 最优性、性能上界或下界、理论精度、计算复杂度
- 不是必须的，特别是对于工程类学科
- 锦上添花
- 对于提升科研水平、发表高质量论文还是很重要的

论文撰写

- 研究工作的最终表现形式
- 科研工作的重要组成部分
 - 动力之一：高水平研究
 - 同行专家的指点
(胡事民：再忙也要看审稿意见)
- “行胜于言” → 敢于说，要得好
 - 好论文是“做”出来的，不是“写”出来的（占**10~30%**）

论文写作的几点建议

评价标准：创新性 → 重要性 → 技术含量 → 表达 (递减)

1. 宜**小题大做**，不易大题小做

2. 清晰的论文结构 → “**新八股**”

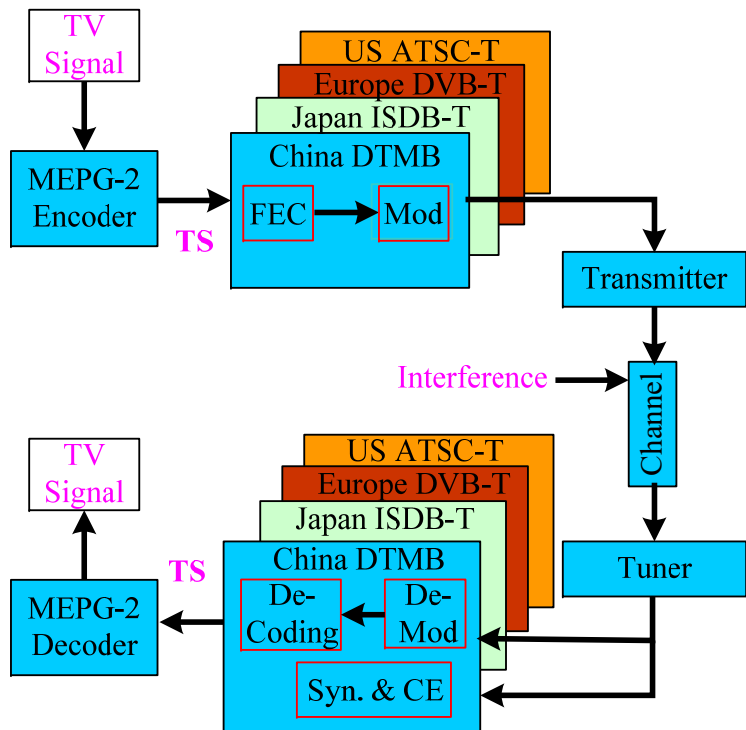
- Problem X is important
- Previous works A, B, and C have been done
- A, B, and C have their weakness
- Your work D
- Theoretic analysis
- Experimental comparison against A, B, and C
- Strength and weakness of D
(龚克：画龙点睛，给人“原来如此”的豁然开朗之感)
- Future works on D

论文写作的几点建议

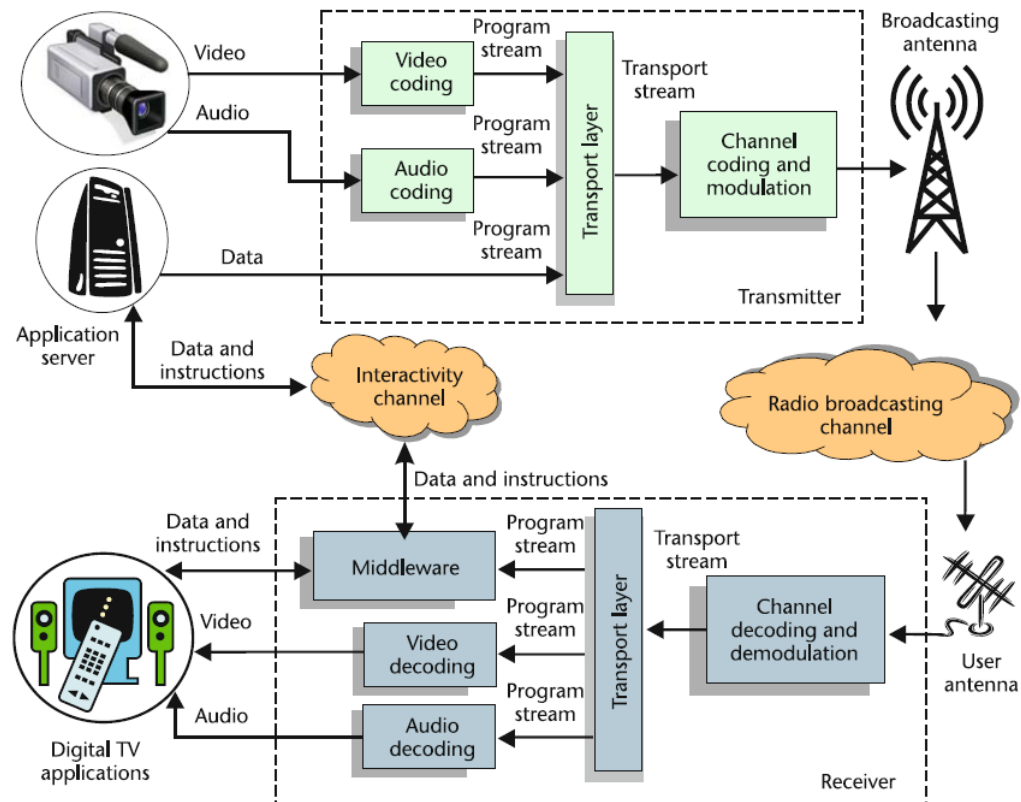
3. 简而美

You are showing your thoughts instead of confusing the readers !

旧图:



新图:



论文发表：第三境



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Zhaocheng Wang received his B.S., M.S. and Ph.D. degrees from Tsinghua University in 1991, 1993 and 1996, respectively. From 1996 to 1997, he was with Nanyang Technological University (NTU) in Singapore as a Post Doctoral Fellow. From 1997 to 1999, he was with OKI Techno Centre (Singapore) Pte. Ltd., firstly as a research engineer and then as a senior engineer. From 1999 to 2009, he worked at SONY Deutschland GmbH, firstly as a senior engineer and then as a principal engineer. He is currently a Professor at the Department of Electronic

Engineering, Tsinghua University. His research areas include wireless communications, digital broadcasting and millimeter wave communications. He holds 22 granted US/EU patents and has published over 60 technical papers. He has served as technical program committee co-chair/member of many international conferences. He is a Senior Member of IEEE and a Fellow of IET.



Zhixing Yang received his B.S. degree from the Department of Electronic Engineering, Tsinghua University, Beijing, China, in 1970. He is now a full professor at the Department of Electronics Engineering of Tsinghua University, Beijing, China. He is the executive director of the State Key Laboratory on Microwave and Digital Communications, China, and the executive director of the development group of the digital television terrestrial broadcasting state standard for China. He received several national awards and held dozens of patents. His research

interests are in high-speed data transmission over broadband digital television terrestrial broadcasting, wireless links, wireless communication theory and communication systems design. He is a Senior Member of IEEE.

“众里寻他千百度，蓦然回首，那人却在灯火阑珊处”的欣慰和喜悦

寄语

梁启超：“少年智则国智，少年强则国强”

互联网企业创始人创业时年龄

- facebook: mark zuckerberg 19岁
- 微软: bill gates 20岁
- 微软: paul allen 22岁
- 苹果: steve jobs 21岁
- 苹果: steve wozniak 25岁
- google: sergey brin 25岁
- google: larry pages 25岁
- 雅虎: 杨致远 26岁
- 雅虎: david filo 28岁
- skype: janus friis 26岁
- skype: niklas zennstrom 36岁
- youtube: chad hurley 27岁
- myspace: tom anderson 27岁
- myspace: chris dewolfe 36岁
- ebay: pierre omiydar 28岁
- amazon: jeff bezos 30岁
- paypal: max levchin 23岁
- paypal: peter thiel 31岁



国之栋梁：学术大师、兴业之士、治国之才



祝各位早日找到兔子，打兔子愉快 😊