Syllabus - Summer 2018 (6/25-6/29/2018)

课程名称: **大数据时代的系统芯片设计** (**SoC Design in Big Data Era)**

主讲教师: 陈春章 博士 (CZ Chen, PhD)

课程描述（**Course Description**）

This course will discuss the impact of big data on concurrent technology in the integrated circuit (IC) field especially on SoC (system-on-chip) design, its integration and implementation.

In recent years, AI has become a hot topic and invoked urgent discussions on from Machine Learning to Deep Learning hence related IC designs. These include, e.g. CMOS neuromorphic design based on CNN algorithms, HSA/ASIC/FPGA designs in a CPU/GPU/DSP kernel, in addition to various usage of memories such as HBM/3D/SDD. IC in/for AI on the stake needs are arrived from big data generation via the Internet of Things (IoT), where the data are collected via the Cloud, converted via an IoT device to electronic signal, which are stored, analyzed, processed and protected. In all of these steps, IC/SoC chips play a key role. AI/IoT/Cloud/SoC are tightly bundled to form and to touch base the foundation of SoC design in the big data era.

To meet the big data era needs, for IoT device and electronic end products, used either in wearables or portables, in handsets or in communical, in computational and transportation appliances such as automobiles, it has brought in increasingly complexity of the SoC design, as well as many challenges to the engineering team. The issues to deal with include 1) at system level design to run verification using various models; 2) to achieve high performance of clocks; 3) to use ultra low power features; 4) to produce high reliable products at high yield. The importance of design for reliability has become not only a quality measure for high-end products, but also a necessity in today's consumer electronic products.

The class will focus on the emerging and developing technology from AI and Big Data to IoT/Cloud related and applied in today's communication, computing and consumer products. Throughout the class, the students are expected to learn of the state of the art of SoC design methodology, with the comprehensive and compressed teaching materials.

1 主要教学内容 （**Course Contents**）：

(1) Impact of Big Data (in AI and IoT) on SoC Designs

(2) IDM/EDA/IP and System Designs

(3) SoC/IC Design and Its Implementation

(4) Design For eXcellence (DFX)

(5) Advanced Technology and Summary

2   课程作业（**Coursework**）：

2.1 课程得分（Score Percentiles）: Class Attendance (20%), Completion of Course Report (80%). *The final scores is reported to the office of school's administration.*

2.2 课程报告截止时间（Due Date of Course Report）: Friday, July 13, 2018. *Course Report is due in 2 weeks at the end of class.*

2.3 课程报告形式：研究文章（Research Paper）或者研究报告（Research Report），步骤如下。

（1）**Chose writing Options** for Course Report: Option 1 and Option 2.

Option 1: submit a Research Paper in an IEEE format, which should contain 3-5 pages, in either English or Chinese.

Option 2: submit a Research Report in a project report format, which should contain 6-10 pages, in either English or Chinese.

In general, it is recommended that a total of 3,000 words (or 3-5 pages) if written in English or 6,000 words (6-12) pages if written in Chinese should fulfill.

（2）**Chose Course Report Title** (see below): Titles on Group 1 are for Research Paper, Titles in Group 2 are for Research Report. *Pick only one title of them.*

（3）**Chose Course Report Format**:   chose one format from one of the following provided, "Research_paper_template1.doc" or "Research_paper_template2.doc".

Report Title, Author Name(s), Paper Contact Person's Email and **Affiliation(s)** of author(s) should appear on top of the paper. *You may use the sample paper "CSTIC_2017_Symposium_9-16_Chen_Hu2.pdf" as a sample reference.*

Abstract: provide a short abstract paragraph, and list of **key words**.

The content of Course Report should be related to current course, i.e. "SoC Design in Big Data Era and/or IoT related applications", see "Recommended course report titles" below.

If 2-3 people work in a group, the role and contribution must be claimed for each individual for the work to have contributed. Write a footnote for this.

2.4 Submission: please submit the Class Report via Email

Email to（收件人）: czchen126@126.com

Subject（主题）: **Title** of the report, **Name** of the contact author.

3 推荐题目 Recommended titles of Research Paper or Research Report

Select one of the following topics (or create your own topic) within the class scope.

3.1 **Group 1 (Option 1)**, Titles for a Research Paper:

1. Architecture Design and Verification of a *{AI chip, IoT chip or MCU or SoC}*

2. Design and Integration of *{RapidIO IP}* in *{Communication SoC}*, in relation to a potential Application of Big Data scenario

3. A Study of "XNN" Algorithm and Its {System Architecture | Verilog Coding | Verification and} Design Implementation.

4. A low power SoC design for IoT fitting on NB IoT (LPWAN)

5. A Study of *{ESD Models}* and Design-For-Reliability

3.2 **Group 2 (Option 2)**, Titles for a Research Report:

1. Overview of SoC Design Features in {AI Application | Big Data Era}

2. Review of Types of Architecture Design (CPU/GPU/DSP/ASIC/FPGA) for AI Applications

3. IPs in a SoC design for IoT wearable/SmartHome/SmartCity

4. Integration of {3D | HBM | eFlash | SDD} in an {AI | Big Data | Data Center} Chip Design

5. EDA flow for a neuromorphic based SoC design containing CPU/GPU/DSP etc

6. Comparison of 28nm Design between Bulk CMOS and FD-SOI Technologies

7. ASIC Design methodology using TPU Flow2 with FPGA+CPU

8. *{Ionizing Radiation}* Induced Reliability Issues in FPGA Designs

4 参考文献（**Sample References**）

1. Chen, C. -Z. and Hu, D.Y., 2017, Geometry Effect with Respect to ESD and Radiative Charged Particles in SoC. Semiconductor Technology International Conference (CSTIC), 2017 China. (March 12-13, 2017, Shanghai.) **IEEE Conference Publications,** http://ieeexplore.ieee.org/document/7919894/ **(pp. 1-3,** DOI: 10.1109/CSTIC.2017.7919894)

2. 翻译《数字模拟混合信号集成电路设计方法学指导》, 科学出版社(2015 年 1 月, ISBN 978-7-03-041959-0) 陈春章 何乐年 李智群 艾霞 等译

3. 专著《数字集成电路物理设计》, 科学出版社出版(2008 年 8 月, ISBN 978-7-03-022031-8) 陈春章 艾霞 王国雄 著

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