2017 IEEE International Symposium
On Intelligent Signal Processing and
Communication Systems

NOVEMBER 6-9, 2017, XIAMEN, CHINA

Participation Report

Gunma University
Graduate School of Science and Technology
Kobayashi Laboratory
The First Year of Doctoral Program
Yifei Sun

Symposium name: 2017 IEEE International Symposium on Intelligent Signal Processing and Communication Systems (ISPACS2017)

Host location: Wanda Realm Xiamen North Bay Hotel, Xiamen, China

Holding date: November 6-9, 2017

Schedule:

November 6:	Take plane to Xiamen	Conference registration
November 7~9:	Lecture session	
November 10:	Gulangyu Island tourism	
November 11:	Return to Japan	

Publish paper: Gray-code Input DAC Architecture for Clean Signal Generation
Writer: Richen Jiang, Gopal Adhikari, Yifei Sun, Dan Yao, Rino Takahashi, Yuki Ozawa, Nobukazu Tsukiji, Haruo Kobayashi and Ryoji Shiota

1. Symposium and host location

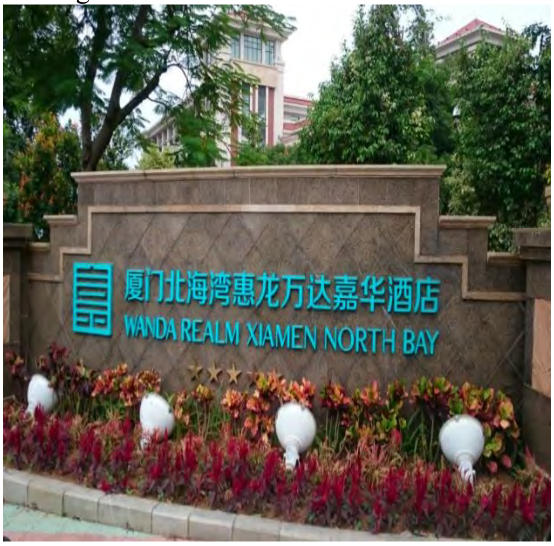
2017 IEEE International Symposium on Intelligent Signal Processing and Communication Systems (ISPACS2017), sponsored by the IEEE Circuits and Systems Society and hosted by Huaqiao University, China. ISPACS had been initiated in 1992 and circulated around the pacific region, ISPACS 2017 is the twenty-fifth ISPACS. It includes communication systems, multimedia systems, signal processing, VLSI design, circuits and systems, emerging technologies in the signal processing and communication areas.

Xiamen is a well-known tourist port city in the southeast coast of China, is the second largest city in Fujian province. Xiamen and the surrounding southern Fujian countryside are the ancestral home to large communities of overseas Chinese in Southeast Asia and Taiwan.

2. Program

November 6: registration

We took a plane from Narita International Airport (Japan) to Xiamen Gaoqi International Airport (china). From 9:55 to 13:45, the time difference between Japan and China is 1 hour. Afternoon was registration time.



Host location: Wanda Realm Xiamen North Bay Hotel

Registration

The hotel is close to the sea, after registration. We took a group photo outside the conference hall

November 7: conference

8:30 ~ 9:30 Opening Ceremony
9:30 ~10:30 Keynote Speech 1: Why Deep Learning Networks Work So Well?
10:50 ~11:50 Keynote Speech 2: The Active Efficient Coding Framework for the Joint Emergence of Perception and Behavior
14:30~15:50 建龍さん publish

Opening ceremony

Keynote speech 1

November 8: conference

8:30 ~ 9:30 Keynote Speech 3: When Optical Spectra Meet Big Data for Wireless Communications
9:50 ~10:50 Keynote Speech 4: Gated Deep Neural Networks for Adaptive Information Flow
14:30~ 17:40 井田さん、高橋さん、小澤さんは、姚さん、福田さん publish
18:30~21:00 Banquet


Banquet hall

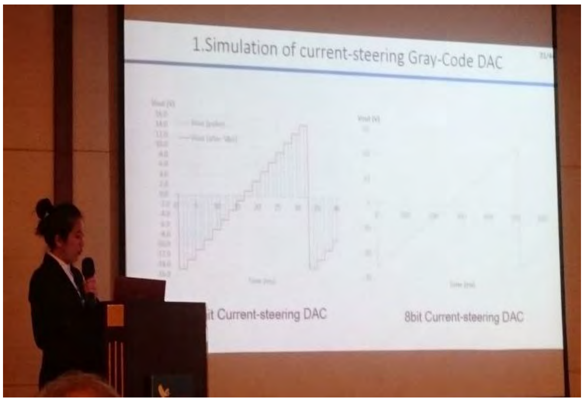

Traditional instrument

November 9: conference

8:30 ~ 11:30 新井さん、櫻井さん、石井さん、熊さん、小堀先生、サハンさん、三木さん、私 Publish.
12:40 ~ 18:00 Social Event

My publish paper title is *Gray-code Input DAC Architecture for Clean Signal Generation*. Publishing time was 15 minute, and question time was 5 minute. Because it was my first time to publication of the international conference, I was a little bit nervous. In the future, we need more exercises and improve our level of English listening and speaking in order to answer questions in our research area.

Chair man: Professor Kobayashi



When I publish

November 10: visit

Scenic spot: Gulangyu Island

Gulangyu, separated from Xiamen by the 500-metre-wide Egret River, with an area of 1.77 square kilometers, enjoys a title “Garden on the Sea.” Many well-preserved island with a variety of Chinese and foreign architectural style of buildings, is called “the exhibition of world architecture”.

Gulangyu dock: just one way to island—boat

Island scenery

Gulangyu group photo

November 11: come back to Japan.

Experience:

It was my first time to publication of the international conference, and gained a lot of experiences. The participation of this conference is helpful to my future research and study. I also realized the English is very important, and I will improve English level in the future. As an international student, it is a pleasure to go back to my own country to participant this conference. Thank teacher H. Kobayashi for giving me this rare opportunity. In the process of participating in the conference, I not only had a better understanding of my own research knowledge, but also known other major knowledge.

Xiamen is an very beautiful tourist port, and annual average temperature is 21℃. In Xiamen we tasted the special food and experienced different humanistic customs. The participation of this international conference was an unforgettable experience in my life.

Acknowledgments:

First of all, thank the teacher H. Kobayashi for giving me this opportunity. Thank you for your guidance and help. Thanks for teacher H. Lin for taking care of us in Xiamen, pick up us at the airport and send special products for us. Thanks for Gunma University Industrial Association International Internship scholarship to support this international conference. Then thanks for teacher Y. Kobori who gave me guidance for accompanying. Thanks for Mr. N. Ishikawa who gave us support for traveling. At last, thanks for teacher H. San and host unit. It was a very valuable experience for me.

IEEE International Symposium on Intelligent Signal Processing and Communication Systems 2017

NOVEMBER 6-9, 2017, XIAMEN, CHINA

November 17, 2017

ISPACS-2017 Participation report

Gunma University
Kobayashi Laboratory Master 1st Year
Dan Yao

Conference name

IEEE International Symposium on International Symposium
on Intelligent Signal Processing and Communication Systems 2017 (ISPACS-2017)

Duration
November 6-9,2017

Venue
Wanda Realm Xiamen North Bay Hotel, Xiamen, China

Papers published

DAC LINEARITY IMPROVEMENT WITH LAYOUT TECHNIQUE USING MAGIC AND LATIN SQUARES

Itinerary

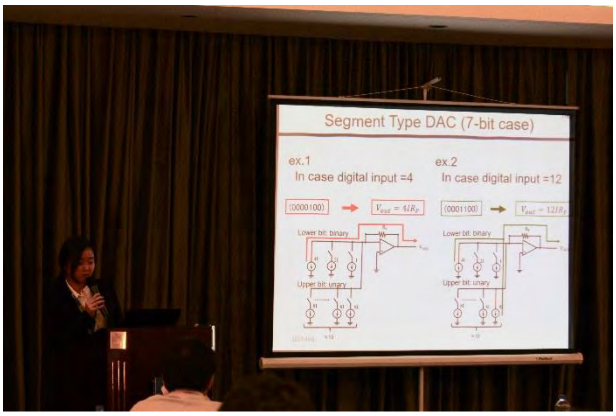
11/6 Departure from Haneda Airport
11/7 Academic participation
11/8 Academic participation (Presentation)
11/9 Academic participation
11/10 Sightseeing in Kulangsu island
11/11 Departure China Xiamen Takasaki International Airport

About ISPACS

ISPACS is an academic conference handling signal processing and communication system sponsored by IEEE and Huaquiao University, etc. In the past, it has been held in Asian countries such as Indonesia and Thailand as well as Japan. Most participants are from Asia.

Presentation

It was the first time I attended a large institute, and I was very excited. I can see the content of scholars from all over the world. At the time of my publication on Nov. 8, I could discuss my research with other scholars and know what's missing. However, I forgot the words in some places. In order to make a presentation smoothly without looking at the manuscript, for what I want to convey on this slide now, and what I want to tell the most, I thought that I should be able to express them in my English.



I received Questions and answers as well as comments after the announcement, I could not speak English well to think the things I want to say, I felt that my English proficiency is at the low of the low.

Photograph




海湾公园




ACKNOWLEDGEMENT

I am very happy to go to my country with my classmates and professors in the lab. For me, this is the first time I went to Xiamen. I can sightsee the scenery of Xiamen and eating my country's cuisine is very happy

I would like to thank Professor H. Kobayashi and my lab members as well as Prof. H. Lin, who gave me such valuable opportunities. Thank you very much.

Invited Paper

Measurement and Control Technology in Analog IC Design

Takanori KOMURO 1), Haruo KOBAYASHI , Masashi KONO
Hai-Jun LIN, Yasunori KOBORI

1) Agilent Technologies International, Japan, Ltd., 9-1 Takakura-cho Hachioji Tokyo 192-0033

Department of Electronic Engineering, Graduate School of Engineering, Gunma University,
1-5-1 Tenjin-cho Kiryu Gunma, 376-8515, JAPAN
takanori_komuro@agilent.com, k_haruo@el.gunma-u.ac.jp

Keywords: Measurement, Control, Analog, Mixed-Signal, Calibration

Section 1: Introduction

Analog technology is very important in commercial and industrial instruments and systems – such as measuring instruments and automatic control systems -- that have analog inputs and outputs. Consumer equipment drives demand for improvements in analog circuit performance, and this naturally leads to performance improvements in commercial and industrial equipment.

Fig.1 shows a representative piece of high-end measuring equipment: a new digital oscilloscope with 40Gsps ADC. This ADC is fabricated using an ordinary CMOS process which is mainly used for consumer applications. This example shows clearly that improvements in methods of fabricating analog circuits for consumer use can lead to improvements in measurement instruments. However, it is also true that it is impossible to achieve such high performance just by using the latest CMOS process. The power consumption of the ADC is much higher than usual consumer devices, so it requires special cooling techniques.

Fig.1 Outlook of Agilent DSO80000B series digital oscilloscope.

The converse also applies: even in LSIs used for ordinary consumer equipment, like audio-visual equipment and cellular phones, we often find techniques that originated in measuring instruments and automatic control systems. In this paper, we would like to argue that measuring and automatic control technologies can provide valuable tools in designing high-performance analog and mixed-signal integrated circuits:

Section 2: Calibration - Basic Theory and Background

“Calibration” is an important part of measurement technology. In measurement applications, we understand “calibration” to mean “to guarantee the performance” and “to maintain traceability to national standards”. Nowadays we sometimes find the term “calibration” used to mean “self-tuning”, or “error correction” in analog LSI design for consumer equipment.

Fig.2 shows the block diagram of a simple measurement system with offset-compensation functions. This system measures and displays the input voltage. When offset-voltage-compensating calibration is started, the input of this system is connected to 0V and the value of the offset voltage is stored in a memory device. Then, in measurement mode, we subtract the stored offset value from the raw data to obtain the offset-compensated result. By such automatic offset-compensation, we can eliminate offset voltage error.

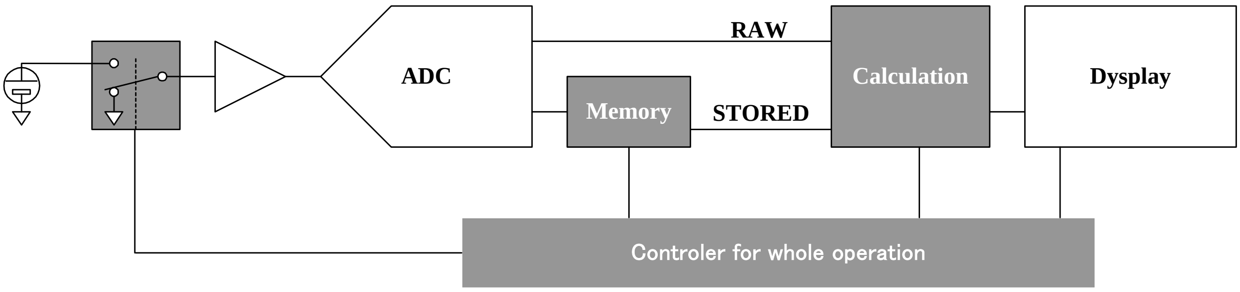


Fig.2: Block diagram of a simple measurement system with calibration function.

In addition to the essential measuring functions, this compensation method requires additional elements: a connection circuit which switches the input between the input to be measured (from outside the system) and a known calibration voltage, memory devices for storing the measured offset value for offset compensation, calculation functions, and a controller to sequence the whole operation. In the past, adding such elements increased the cost, which was difficult to justify for cost-sensitive applications like consumer equipment.

However nowadays, thanks to the rapid progress in CMOS technology, this situation is changing. The cost of building such elements with CMOS digital circuits, the cost of memory, calculation circuits and controller can be quite small. Furthermore, because SoC (System on a Chip) devices for consumer application include embedded MCUs (Micro Control Units) such as ARM processors, it is possible to realize calibration functions simply by developing software. Hence, even for cost sensitive consumer devices, it is becoming practical to use calibration to improve analog performance and reliability.

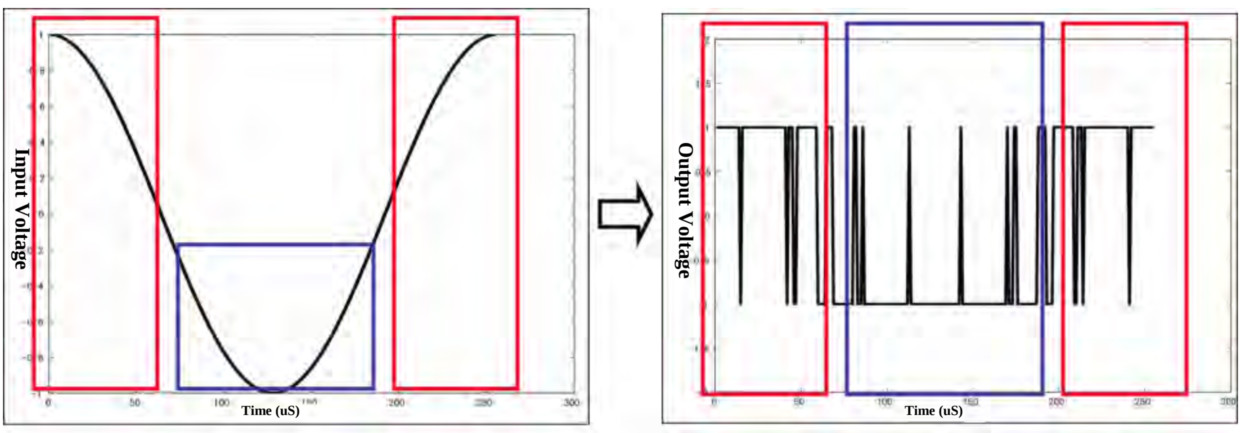
Section3: Repeatability and Reference

The cost of digital circuitry is not the only consideration when trying to improve analog performance by adding calibration functions to consumer ICs. In Fig.2, if the offset voltage of this system changes from the value stored at calibration time, the offset error is not cancelled. Hence offset voltage itself is not a problem, but the stability – the “repeatability” -- of the value is important.

In usual analog IC design, the main cause of repeatability degradation is temperature fluctuation. So in classical methods of designing analog ICs with calibration, we need to take much care in minimizing thermal drift. However in modern designs, we can repeat calibration very frequently. For example, if we repeat calibration at one-second intervals, it is possible to cancel thermal drift caused by slow changes in room temperature. Furthermore, nowadays it is also possible to repeat calibration at intervals as small as one millisecond or less.

Next we would like to mention the importance of the reference signal. Even if we perform frequent calibration to cancel thermal drift, the calibration will be meaningless if the reference voltage used for calibration varies with temperature. In other words, the stability of the reference voltage cannot be improved by calibration, and therefore we have to prepare a stable reference. Here I would like to emphasize that it is much easier to prepare a stable reference than to keep the whole system stable against temperature fluctuation. In practical circuits, inexpensive voltage reference devices, such as band-gap (or Zener) references, are widely used for this purpose.

Because of rapid progress in CMOS digital systems, it has becomes possible to perform complex arithmetic calculations for sophisticated calibration within LSIs. But for the calibration to be meaningful, it is important to prepare a proper reference. For example, to cancel the non-linearity of an analog circuit, such as an ADC, we need to prepare a stable variable-voltage reference with sufficient linearity. And from the viewpoint of IC design, this proper reference has to be realized inexpensively, within an LSI circuit.



PWM Input Signal PWM Output Signal

Fig.3 Explanation of PWM signal.

One way to solve this problem is to use PWM (Pulse Width Modulation) with a stable clock. By using PWM, we can generate a voltage proportional to the number of pulses with a uniform period. Since it is based on "counting", it can be realized using digital circuitry, and also the PWM signal is linear enough for most applications. Fig.3 shows the basic operation of PWM.

By using such techniques, we can perform effective and complex linearity compensation even in LSIs.

Section 4: Control Theory Applied to Analog IC Design

Automatic control technology is another important field in industrial equipment.

Control theory was initially developed for systems like chemical and steel plants. But, nowadays, control theory cannot be ignored in analog IC design.

Here we would like to introduce an example which shows the effectiveness of applying control theory to analog circuit design. Track and Hold (T/H) circuits are a key component of many ADCs (Fig.4). They hold the input voltage while one AD conversion is being performed (hold mode). As soon as the conversion completes, T/H again follows the input signal (track mode). The total conversion time of the ADC is decided by the sum of the hold period and the track period. The hold period depends on the method of AD conversion, and the track period depends on the speed of T/H circuit; therefore optimization of the T/H circuit is important to maximize the conversion rate of the ADC.

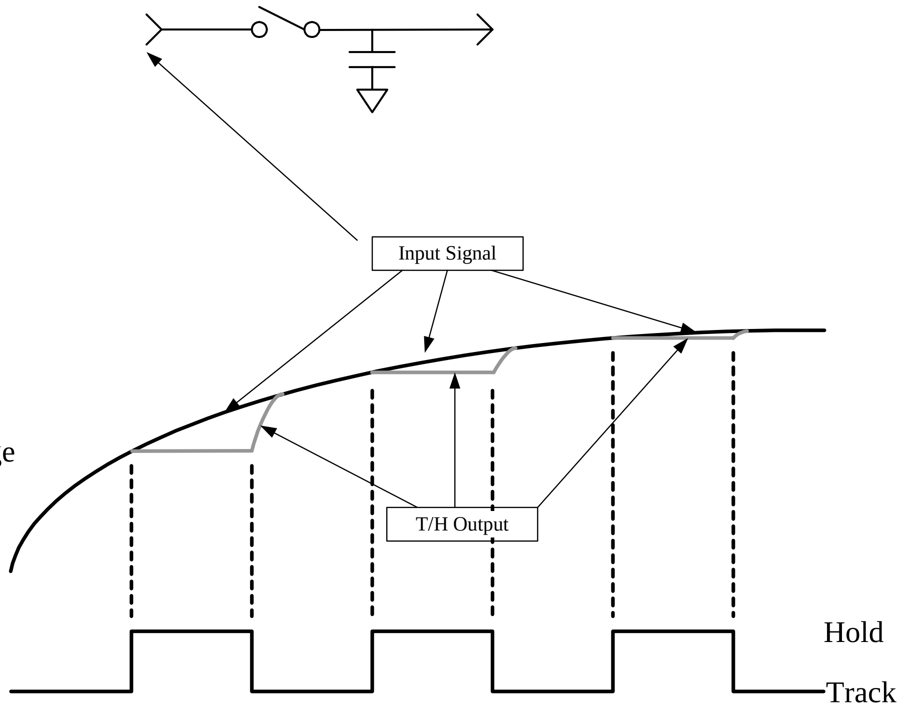
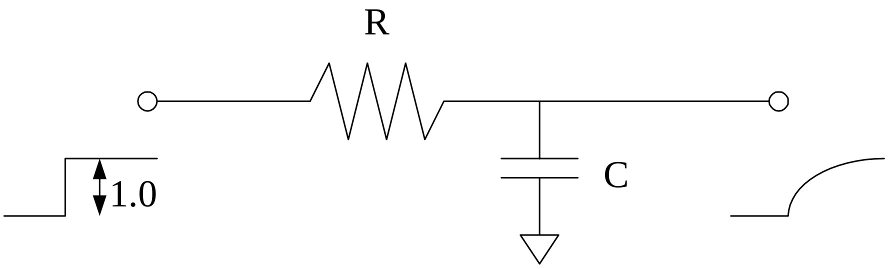
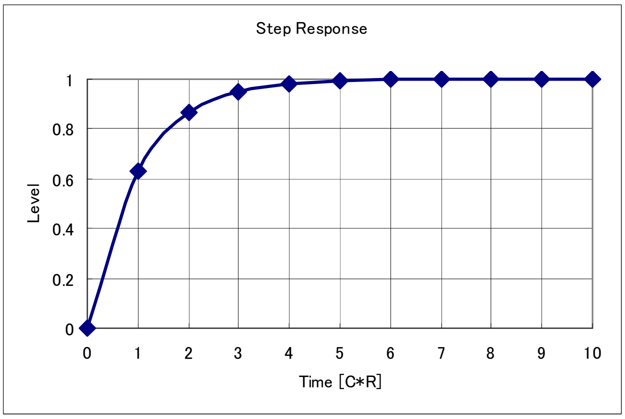


Fig.4: Operation of a track and hold circuit.

Fig.5 shows a simplified model of a T/H circuit. In hold mode, the switch in the figure is kept open, so electric charge stored in the capacitor cannot leak, and the voltage across the capacitor is kept at a fixed value. In track mode, the switch is closed, so the capacitor is charged up to the same voltage as the input. But the switch in the T/H circuit is usually made using CMOS transistors, so a real-world switch has some resistance. (R). Hence, the optimization of T/H circuits is recognizable as a single-pole step-response problem in control theory.

In the practical design of T/H circuits, other parasitic elements exist, so the optimization problem becomes more complex. It is not good to depend only on sixth sense in solving such complex problems -- control theory is of more help in reaching an optimal solution.





$$f(t) = 1 - e^{-\frac{t}{c*R}}$$

t = 6.91c*R

f(t) = 0.99999

Fig.5: Simplified model of the track and hold circuit.

The second example is the design of switching DC-DC converters (Buck-Boost converters) with PWM or PFM (Delta-Sigma modulation) control signals [1]. Precise control requires accurate control voltage signals with small ripple. A controller with fast response maintains good voltage regulation (with small overshoot/undershoot) for an output current step. In power systems, location of the power supplies to reduce stray inductance in layout patterns is very important, because inductance delays the response and degrades the regulation.

Section 5: Other Examples of Industrial Techniques Applicable to Analog IC design

Here are some other examples of measurement and control techniques applicable to analog integrated circuit design. Some of them will be suitable topics for discussion at the conference:

Here are some other examples of measurement and control techniques applicable to analog integrated circuit design. Some of them will be suitable topics for discussion at the conference:

- Self-calibration techniques in ADC/DAC and also RF circuits and systems.
- Digital error correction techniques with redundant hardware in ADC/DAC [2].
- Accurate and robust bias voltage regulators that are not affected by variation in process, supply voltage, or temperature.

● Automatic tuning of cut-off frequency and Q-value in continuous-time analog filters.
● On-chip monitoring circuitry (measuring power supply voltage fluctuation, timing jitter etc.)
● Control systems for power supplies (DC-DC converters) with fast response and low ripple.
● Automatic gain control circuits.
● Design and analysis methodology, such as Laplace transforms, Fourier transforms, Bode charts, Nyquist stability criteria, Routh-Hurwitz stability criteria, transfer functions, impulse response, step response (linear system theory, feedback theory)
● Operational amplifier design (especially stability problems, phase margin, gain margin)
● Spread-spectrum clocking of digital circuitry and switching regulators for EMI reduction [3].
● Sampling techniques (oversampling, equivalent-time sampling, sequential sampling, random sampling, subsampling, down-sampling, up-sampling, impulse sampling, sampling rate conversion) [4].
● Built-in-self-test (BIST) and built-out-self-test (BOST), especially for analog circuit testing [5].
● Stability studies for higher-order delta-sigma modulators.

Section 6: Possible Collaboration with Others

We would like to collaborate with researchers in measurement and control fields who are interested in analog technologies; our target is development of high performance analog ICs.

Section 7: Conclusion

In conclusion, we have found that measurement and automatic control technologies that were originally developed for commercial and industrial use can provide effective tools for high-performance next-generation analog IC design.

We would like thank K. Wilkinson for valuable discussions.

References

[1] Y. Kobori, T. Furuya, M.Kono, T. Shimizu, H. Kobayashi, ``A New Control Method for Switched Buck-Boost DC-DC Converters with Delta-siguma Modulation for Mobile Equipment", 2006 International Symposium on Intelligent Signal Processing and Communication Systems, Tottori (Dec. 2006).

[2] M. Hotta, A. Hayakawa, N. Zhao, Y. Takahashi, H. Kobayashi,``SAR ADC Architecture with Digital Error Correction", IEEJ International Analog VLSI Workshop, Hangzhou (Nov. 2006).

[3] T. Daimon, H. Sadamura, T. Shindou, H. Kobayashi, M. Kono, T. Myono, T. Suzuki, S. Kawai, T. Iijima, ``Spread-Spectrum Clocking in Switching Regulators for EMI Reduction", IEICE Trans. on Fundamentals of Electronics, Communications and Computer Sciences, vol. E86-A, no. 2, pp.381-386 (Feb. 2003).

[4] M. Uemori, H. Kobayashi, T. Ichikawa, A. Wada, K. Mashiko, T. Tsukada, M. Hotta,

``High-Speed Continuous-Time Subsampling Bandpass ΔΣAD Modulator Architecture'', IEICE Trans. Fundamentals, E89-A, no.4 (April 2006).
[5] T. Komuro, N. Hayasaka, H. Kobayashi, H. Sakayori, ``A Practical Analog BIST Cooperated with an LSI Tester'', IEICE Trans. Fundamentals, E89-A, no.2, pp.465-468 (Feb. 2006).

Biography of Dr. Takanori KOMURO:

Takanori Komuro received the B.E. degree in electric engineering from University of Tokyo in 1985. Then he joined Yokogawa Electric Corp. Tokyo, Japan, where he was engaged in the research and development of AD converters for measurement instruments. From 1991 to 1995, he was involved in the research project, Superconducting Sensor Laboratory, about development of brain activity sensing system (MEG). In 1995, he was invited as researcher by Kanazawa Institute of Technology, where he worked for making MEG system fit for practical use. From 1997, he joined Hewlett-Packard Japan, Ltd., (Currently company name has changed into Agilent Technologies International, Japan, Ltd.), where he involved in development of analog portion, from DC to several GHz, for LSI tester. And he also has researched about test methods for various kind of LSIs. He received Ph.D. degree from Gunma University in 2007.

Biography of Prof. Haruo KOBAYASHI:

Haruo Kobayashi received the B.S. and M.S. degrees in information physics from University of Tokyo in 1980 and 1982 respectively, the M.S. degree in electrical engineering from University of California at Los Angeles（UCLA） in 1989, and the Dr. Eng. degree in electrical engineering from Waseda University in 1995. He joined Yokogawa Electric Corp. Tokyo, Japan in 1982, where he was engaged in the research and development related to measuring instruments and mini-supercomputers. From 1994 to 1997, he was involved in research and development of ultra-high-speed ADCs/DACs at Teratec Corp. In 1997 he joined Gunma University and presently is a Professor in Electronic Engineering Department there. He was also an adjunct lecturer at Waseda University from 1994 to 1997. His research interests include analog & digital integrated circuits design and signal processing algorithms. He received Yokoyama Award in Science and Technology in 2003, and the Best Paper Award from the Japanese Neural Network Society in 1994.

Biography of Mr. Masashi KONO:

Masashi Kono received the B.S. and M.S. degrees in electronic engineering from the Gunma University, Japan in 2003 and 2005, respectively. Currently he is a doctoral course graduate student in electronic engineering department at the same University , where he has been engaged in design and analysis of switching regulator circuits and CMOS analog circuits with MEMS technology. He is a student member of the IEEE, the Institute of Electrical Engineers of Japan (IEEJ) and the Institute of Electronics, Information and Communication Engineers of Japan (IEICE), Japan Institute of Electronics Packaging (JIEP).

Biography of Mr. Hai-Jun Lin:

Hai-Jun Lin received the B.S degree and M.S degree, both in electronic Engineering from Gunma University, Gunma Japan, in 2004 and 2006 respectively. He has been working toward the Ph.D. degree at the same university. His research interests include high frequency analog integrated circuits.

Biography of Prof. Yasunori KOBORI:

Yasunori Kobori received the B.S. and Ph.D. degrees from the Tokyo Institute of Technology in 1974 and 2000, respectively. From 1974 to 2001, he worked for Hitachi, and researched for the servo control system of VTR and video printing system. In 2002, he joined the Department of the Information Engineering of Matsue National College of Technology, Shimane, Japan. He joined the Department of Electrical and Electronic Engineering of Gunma University, Gunma, Japan in 2004 as Guest Professor.

He is a member of IEEE, the Institute of Electrical Engineers of Japan (IEEJ) and the Institute of Electronics, Information and Communication Engineers of Japan (IEICE)