

## **InvenSense brings MEMS gyroscope technology into the consumer electronics market**

### **Interview with InvenSense CEO, Steve Nasiri**

InvenSense was founded in 2003, and received their first funding in 2004. Last year, with famous handset IC vendor, Qualcomm, joined their 2<sup>nd</sup> round financing, InvenSense started getting attention. InvenSense has been chosen as one of “Silicon 60” by EE Times this year, which also proves their potential.

Dual-axis MEMS gyroscope is their main product, which is suitable in the consumer electronic applications such as digital still camera, personal navigation system and cell phone. This is the world first company that enable gyroscope in main stream consumer market. Steve Nasiri, the president and CEO of InvenSense, calls this as disruptive new technology. Several days ago, I had the opportunity to interview with him and discuss the market and application of MEMS gyroscope, and also we discussed the future of this product.

#### **Q: What’s special in InvenSense’s gyroscope? How do you achieve the low-price requirement and bring this technology into consumer applications?**

Our MEMS gyroscope is based on patented Nasiri-fabrication platform technology, which integrates MEMS design and manufacturing, mixed-signal ASIC and wafer-level packaging technology, to bring small size, low cost and high performance gyroscope products.

Among these technologies, the main cost reduction is come from wafer-level-packaging. We combine MEMS wafer on top of CMOS wafer and create hermetic sealed, which will not need additional parts in packaging. This approach dramatically reduces the cost of packaging and testing, which is most costly in conventional gyroscope manufacturing. At the same time, through this technology, enable our dual-axis gyro can sustain more than 10,000g shock and very suitable for any hand held devices.

#### **Q: Are there any applications or designs using this product?**

Gyroscope is to measure angular velocity, to determine motion status, which is why it is also called motion sensor. With this nature, we can use it in digital still camera image stabilization, or providing more accurate position for location based service.

Today, there are several Japanese-brand digital still cameras using our gyroscope in optical image stabilization or electronics image stabilization. There are also several Taiwan manufacturers using our gyroscope in their designs. Our next target application is in portable navigation device (PND), dead reckoning technology which resolves the location problem when GPS signal not available.

When GPS signal blocked or interfered, we will not be able to get precise location from satellites. Through dual-axis gyroscope, the turning and the slope information of the automotive can be acquired. This information can be used to help telling the exact location, and dramatically increase the usability of GPS, this will help to promote location base service. At the moment, there is one major Taiwan PND maker selects our solution, and expects the finished product will be in the market by November. Most of world PNDs are made in Taiwan and this is a very important market for us.

**Q: About Electronics Image Stabilization, will it be as good as optical image stabilization?**

Gyroscope is the critical sensing element no matter it is for optical image stabilization or electronics image stabilization. But optical image stabilization solution is more complicated, size is also big and the cost is around US\$10, this solution is not suitable for low-end DSC or cell phones. Therefore, for those applications, electronics image stabilization is the better choice to provide consumer better picture quality experience. Still, electronics image stabilization still not as good optical image stabilization in term of picture quality.

We are working on combining image sensor, application processor and software to provide a best image stabilization solution and will continue to improve its performance. Besides, for cell phone application, if we can provide multiple features, such as used in GPS and image stabilization, with single MEMS gyroscope, it will be a complete and more attractive feature set for handset makers.

**Q: You mention cell phone applications, with the current solution you have, can your power consumption meet the requirement? What would be the key consideration for cell phone makers?**

Current dual-axis gyroscope, IDG-300, still can't meet cell phone power consumption requirement, but we will have new product that can. Please be reminded, Qualcomm is one of our investors, therefore, we will combine with system design and have better solution in the near future.

For cell phone makers, the competition is fiercely, and they concern cost for every individual feature. They will not consider for feature cost more than \$0.50. Our current solution needs around US\$1.00. If multiple features can be provided with single sensor, such as used in GPS and image stabilization, to make individual feature cost lower than \$0.50, the future market and growth can be huge.

**Q: Besides applications mentioned earlier, what other potential usage and development?**

Like 3D remote controller, air mice, is another rapid growth market. Because getting popular of web TV and home media, consumer desires a more convenient, more intuitive user interface. Compared with today's complicated push-button style remote controller, content navigation using air mouse or 3D remote controller will only need one or two buttons to manipulate menu check list. Today, there is one major computer peripheral vendor using our solution and have

their air mice product, which is now available in the market. We believe this novel user interface will be more popular and more widely used.

**Q: The accelerometer is getting a lot of attention because of Wii. Is gyroscope and accelerometer are competition products?**

I am also very excited with the design trend to utilize accelerometer in gaming platforms, such as Wii. This represents the similar motion sensors can be accepted by consumer. The use of accelerometer has been started quite early. On the other hand, traditionally gyroscope cost has been very high and can't be used in consumer products. Of course, this will change.

Gyroscope is to measure angular velocity and accelerometer measure linear acceleration, the applications are different, in fact, they are more complimentary to each other, and not competition. If we can combine dual-axis gyroscope and tri-axis accelerometer, the motion then can be completely measured, and provide finished products with better performance.

**Q: No matter it is accelerometer or gyroscope, it is already quite a hot topic using this type of technology to create novel user interface. But they are still not widely adopted. What do you think the reason behind?**

This is also one of our strategies in developing new products. To improve system performance, it is not enough to simply provide customers with motion sensors. Solution is equally, if not more important. As an example of our BlurFree technology, we are using the measurement results of hand jittering from our gyroscope and converted into digital format, real time feed into and used by image signal processor (ISP) to create best picture quality.

The solution envelopment needs to be provided with final product in mind, which can, therefore, resolve the issues may encounter during product design. And can shorten time-to-market. Therefore, we also put in a lot of resource in other solutions such as GPS and 3D remote. We will not just provide gyroscope components, and which is the direction we are taking.

**Q: What is your MEMS gyroscope product development blueprint?**

We are working on an integrated 6-axis motion sensing solution, which includes 3-axis of gyroscope and 3-axis of accelerometer. The main purpose is to provide complete motion sensing solution. Of course, cost and size are main consideration during design. But base on Nasiri-fabrication, we will be able to perform wafer level integration and packaging, and put different MEMS motion sensors into one single device. Our advantage makes us possible to realize this integrated product.

What I am trying to emphasis is, gyroscope has been used in products like guiding missile or other military applications, or in school labs. It was seldom seen in commercial applications. It is only 10 years or more, back in early 1990, when gyroscope started in development for commercial purpose. Compared with other semiconductor technology, this is still a young technology. It can be foreseen there are still lots to develop and research. We have high hope and confidence in the future of such technology.

**Steve Nasiri**

Founder and CEO, InvenSense, Inc.

28 years experience in MEMS industry

Vice president and co-founder of Transparent Networks, Inc.

Previous experience include SenSym (Honeywell), NovaSensor (GE), Integrated Sensor Solution (TI) and ISS Nagano

Education:

MBA, Santa Clara University

Master of Science, Mechanical Engineering, San Jose State University

Bachelor of Science, Mechanical Engineering, UC Berkley

Owns (including in process) more than 40 MEMS patents



By: Karen Ko