



Title:

How to make innovations! – Learned by several display innovations

Speaker:

Dr. Haruhiko Okumura, Distinguished Speaker of IEEE CE Society, Toshiba Corporation, Japan

Date:

March 31, 2020, DL Webinar of IEEE CE Society hosted under IEEE Consumer Electronics Society Bombay Chapter

Time:

13:00–14:00 IST

Abstract:

Revolutionary innovations (also called discontinuous innovations) which are often disruptive and new is synonymous with risk-taking and organizations that create revolutionary products or technologies take on the greatest risk because they create new markets.

We can't expect revolutionary innovation so that it is very difficult to start researching such kinds of disruptive technologies.

I'd like to introduce some revolutionary innovative display technologies based on my experience to give you some hints to start them as a researchers by breaking common sense.

At first, I mainly focus on the LCD technologies to create and open new flat panel TV market. In 1990, it was said that the motion blur problem for LCD TVs was impossible to be solved without ultra-fast response materials. However we discovered that the motion blur was caused by not the binary response as a common sense at that time but both drastically degraded gray level response (brightness in the middle between 0% black and 100% white) and the decreases in the driving voltage because of the electrostatic capacity change according to the rotation of the liquid crystal molecules. Based on the novel image-lag mechanism, we invented the overdrive method that is a liquid crystal driving method to emphasize the applied voltage to the liquid crystal only for a certain period according to the change in the pictures (brightness) so that it may compensate the liquid crystal response deterioration. After that, it took more than 13 years to put it on the market. I also would like to tell you about why so much time was required to make the revolutionary innovation.

In addition, as other innovative technologies, I would like to introduce a LCD device technology with wide viewing angle, called IPS, and 3D display technology, especially focusing on innovative idea and concept prototyping stage.

At first, in 1990, we developed and demonstrated at Japan Electronics Show a level-adaptive overdrive (LAO) method for motion pictures for the liquid crystal TVs, commonly referred to as “overdrive”, to reduce gray-level response time to less than one-fourth of the conventional method, in other words, less than 1 TV field period.

Mindful that the lag problem is difficult to solve by liquid crystal material, he discovered that the image-lag was caused by not the binary response but both drastically degraded gray level response (brightness in the middle between 0% black and 100% white) and the decreases in the driving voltage because of the electrostatic capacity change according to the rotation of the liquid crystal molecules. Based on the novel image-lag mechanism, he invented the overdrive method that is a liquid crystal driving method to emphasize the applied voltage to the liquid crystal only for a certain period according to the change in the pictures (brightness) so that it may compensate the liquid crystal response deterioration. In addition to the patent in 5.B, he has conceived of a number of ideas, such as “Image data processing Equipment”(JPB3455677) and “Liquid Crystal Display Equipment”(JPB3346843).

We demonstrated the technical aspects of the overdrive method at SID '92 for the first time in the world. Subsequently, he analyzed the overdrive method and clarified the relationship between optimized overdrive voltage and LCD panel characteristics. The new technological concept he presented greatly impressed many researchers who had believed it was impossible to achieve low-image-lag LCD TV without fast response liquid crystal materials and made a new technological trend.

We also proposed a recursive-type overdrive method for slow response LCDs with bi-level response time of 16.7ms or longer. In 2002, we achieved a 16:9 aspect full-HD display (1920X1080 pixels) for motion picture, and proved that the method made it possible to reduce the response time to less than 16ms gray-level response. In order to apply the overdrive method or a modified version of it to conventional LCDs, however, additional hardware such as a frame memory and an overdrive processing circuit was necessary, which requires additional cost and prevents practical application of the overdrive technology. Therefore, we considered applying it to PCs, whose video memory (or main memory) and CPU can be used as a frame memory and for overdrive processing, respectively, and we succeeded in developing the software processed overdrive method without any additional hardware and cost. In 2002 and 2003, our overdrive method or a modified version of it was first commercialized not only for PCs but also for high-quality TVs with 60Hz, 120Hz and 240Hz and 3D TVs; for example, the TransCube 20 PC manufactured by Toshiba (2003). The method became a de facto standard technology for LCDs for motion pictures.