Automatic micro defect detection in non-repetitive patterns for high-resolution TFT-LCDs

Euiyeol Oh[1], Dae Keun Kim, Jong Sang BAEK and Yoonsik Choe[2]
[1]LG Display R&D center, 245 LG-ro, Wollong-myeon, Paju-si, 413-779, Korea
E-mail: eyoh@lgdisplay.com
[2]Department of Electrical & Electronic Engineering, Yonsei University,
50 Yonsei-ro, Seodaemoon–ku, Seoul, 120-749, Korea
E-mail: yschoe@yonsei.ac.kr

As TFT-LCD panel becomes larger, micro defects can only be identified at high-resolution and high-magnification (more than 10x) images since various types of micro defects of high-resolution TFT-LCD are not easy to be detected by conventional methods at normal magnification (~7.5x). Previous techniques that use template-matching algorithms are not applicable to highly magnified image of TFT-LCDs since high-magnification pixels (more than 10x) of LCD are non-repetitive. Although stitching multiple LCD images enables to use template-matching, it can not be applied to real production line in terms of execution time, as well as it is not invariant to rotation and scale.

In this study we propose an automatic defect detection system in a fine resolution TFT-LCD image at high-magnification rate. This system is based on two main steps, segmentation and defect detection. A first step is to segment two representative defect types such as pixel-region defect and gate-to-date line (G/D) crossover defect using Wiener Filter. For the defect detection at the pixel-region, we identify defects based on SVD (Singular Value Decomposition) and Local Variance, in that pixel-region is patterned. By choosing the dominant singular values, the reconstructed image is able to remove background patterns and recognize candidate defects. Local variance both amplifies the defects and removes noise. At the G/D crossover-region, SURF (Speeded Up Robust Features) descriptors were used since it is applicable for a correspondance set of affine invaraint regions with high computational power. Fig 1. Shows a high reosultion TFT-LCD surface image of size 1500x1500, which includes both pixel-region defect and G/D crossover defect. The defect detection result is illustrated in Fig. 2 and Fig. 3.

Our experiments results show that the detection rate is 98.5% and the false positive rate is 4.3% for 70 test images, achieving a high correctness in determining micro-defects. The detection rate is defined as the number of defects inspected by the proposed system divided by the total number of test images. The main contribution of the system compared to other methods is capable of detecting micro-defect of a high-resolution TFT-LCD surface that does not contain repetitive patterns due to high magnification rate.

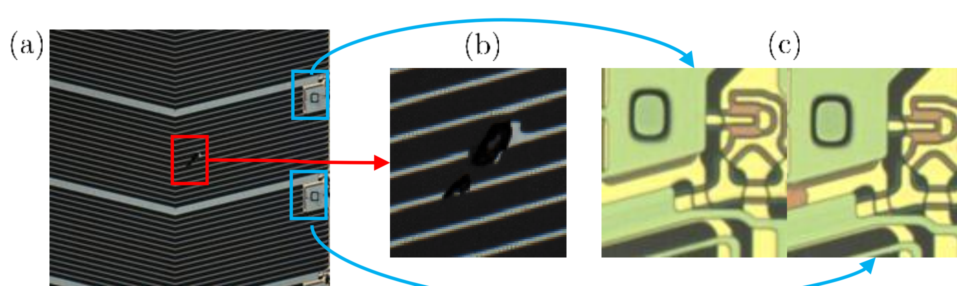

Fig 1.(a) Surface image of a TFT-LCD (1500x1500 resolution at 20x magnification), (b) Pixel-region defect, (c) Gate-to-data line (G/D) Crossover defect

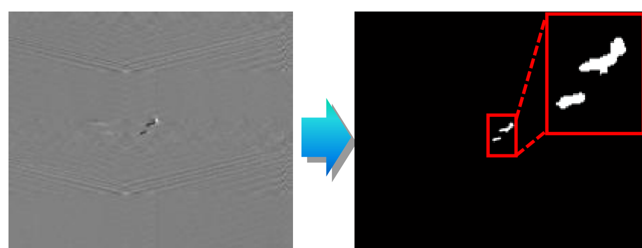

Fig.2. Detection results from pixel-region region

Fig. 3. Detection results from G/D crossover region

References

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