Communication and information processing

Particle size analyzer technique using image processing

Naoyuki AIKAWA (Professor, Department of Applied Electronics, Faculty of Advanced Engineering, Tokyo University of Science)

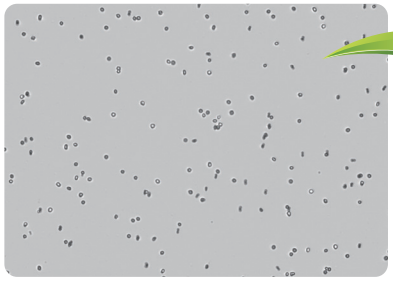
Purpose of Research

Detection of tumor cells circulating in the blood is usually conducted by visualization using reagents and microscopic observation by physicians. However, it requires effort and cost, and individual differences may occur during microscopic observation; therefore, a convenient method to detect tumor cells is required. Tumor cells circulating in the blood are large and distorted compared with normal cells, and a particle size analyzer may aid in detection to some degree. However, commercial particle size analyzers target industrial products and are not appropriate for blood cell analysis. Therefore, this study aimed to develop a particle size analyzer technique that was appropriate for blood cells. In addition, the analysis technique placed an emphasis on versatility.

Summary of Research

Using an image processing technology, the size and shape of blood cells were measured from the images of blood, and the particle size distribution for each shape was obtained. Based on this information, an algorithm that detects cells that have a high probability of being tumor cells circulating in the blood was developed. Compared with conventional particle size analyzers, the analyzer used in our research has a higher resolution. In addition, the software used for conventional particle size analyzers can only be used for that specific analyzer; however, our software can be used with ordinary personal computers, and as long as a microscope image of blood is available, detecting cells with a high probability of being tumor cells circulating in the blood is possible.

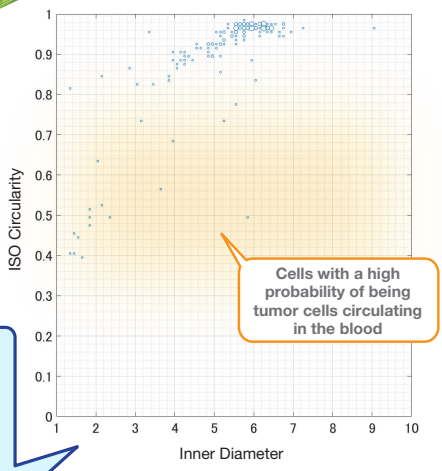
Analysis of a blood image using the software



Blood image of a 14-year-old female dog (Welsh Corgi) with liposarcoma (under the skin of the right shoulder).

Blood Image

Result of blood cell size distribution analysis



x-axis: Inner diameter

y-axis: Circularity = Diameter of the circle with the same area as the cell / Diameter of circle with same circumference as the cell

* If the diameter is large and circularity is small, it has a high probability of being a tumor cell circulating in the blood.

Comparison with Conventional or Competitive Technologies

- Shape, size, and distribution in a blood image of 3840 × 2748 pixels are measurable in approximately 2 s.
- Robust to noise
- High resolution

Expected Applications

- Software to detect tumor cells circulating in the blood using a blood image.

Challenges in Implementation

- Increasing the number of detection experiments to improve precision and to validate robustness to noise

What We Expect from Companies

We are looking to collaborate with a company that would develop the user interface of this software and work on it commercialization.

Points

- **Optimal for particle size distribution measurement of blood cells**
- **Usable with an ordinary personal computer (does not require specialized equipment)**
- **Measurement is possible with a microscope image of blood (no blood sample required)**

Future Developments

- Speeding-up of processing with a graphics processing unit (GPU)
- Classification of detected blood cells

■Awards:

- The Institute of Electrical Engineers of Japan, Prize of Progress from the Technical Committee (2013.03.07)
- IEEE Information Theory Society Japan Chapter Travel Support Award for Young Researchers (2012.10.30), etc.