Обробка інформації в складних технічних системах

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Al-Janabi Aqeel Bahp Tarkhan

Cherkasy State Technological University, Cherkasy

COMPUTER VISION SYSTEM FOR FROTH FLOTATION BASED ON CENTROID

A lot of classic research talked about the process of controlling the flotation process. Using classical mathematical methods, for example, find the edge detection and measure the size, color and speed of the bubbles in the froth. However, not been touched to take the signature of the froth as one part. Through systems which can control state to decide the kinetic and making the right decision to correct processing of the flotation, or judgment on the course of its progress, if they are. Therefore, this research proposes and discusses the possibility of finding this signature, by measuring the deviation at the mass center of a series of successive images, for one minute at a rate of scene per 2 seconds of time(30 scene/minute), from the point of origin of the scene (Image). Introduced signature on an expert system has been pre-instruction, we can see the status of the entire the processing and perpetuate the results of the control system is responsible for the operation.

Keywords: *computer vision, Image signature flotation control, image processing, flotation.*

Floatation Processing

The process begins with the grinding circuit, where the ore first crushed, and then milled to obtain a particle size distribution that is typically sub 100мм. The desired particle size distribution differs from mine to mine, and is typically a function of the mineralogy of the ore) [1].

The reason for the grinding is to liberate the grains of the desired mineral(s) [2]. Water added to the mills to transport the ore through the mill and onwards to the classification section. The mix of ore and water known as slurry. Closed loop control milling achieved by using a classification circuit. This typically achieved using either hydro-cyclones or a set of screens.

Hydro-cyclones are density separation devices that have an underflow of coarse particles and an overflow of fine particles. For a screen, the fine particles pass through the screen, while the coarse particles do not. In both cases, the coarse particles fed back to the mill for re-grinding. The fine particles passed on to the flotation section. It is not common to have multiple mills, screens and hydro-cyclones in the grinding circuit.

The slurry pumped from the conditioning tanks into the first flotation cell. A Flotation cell is essentially a large tank that contains an impeller to agitate the slurry/air mix, and by so doing, promote contacting between air bubbles and particles in the slurry. In some flotation cells, the rate at which air, is fixed, while in other models it is possible to set an airflow rate to a desired amount.

The agitation from the impeller creates turbulence within the flotation cell. The turbulence in turn promotes particle-bubble collisions. Hydrophobic particles will attach to the air bubbles, and rise to the surface. The air bubbles form a froth layer on top of the pulp (slurry). The froth layer overflows the top of the cell into a launder, where the concentrated material is collected. The upward motion of the air bubbles results in the unselective transport of particles to the froth layer in the bubbles slipstream.

Flotation banks generally arranged in banks to allow multistage treatment of the slurry, with recycle loops to ensure that no excess of valuables is lost in the final tailings. The floatation process shown in fig. 1.

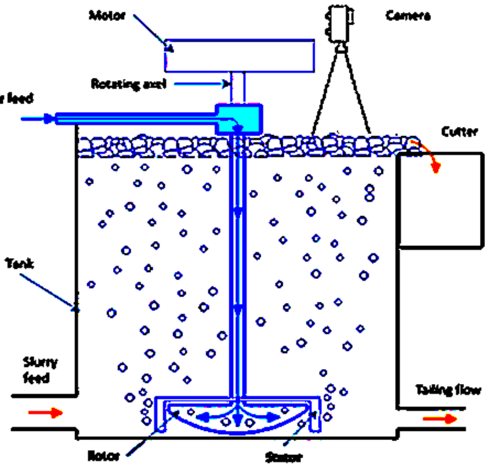

Fig. 1. The floatation process

Difficulties with flotation control

The variables that affect the flotation process are numerous and varied [3]. They include:

- Feed characteristics (mass flow rate, mineral composition, liberation size, particle size dis-tribution, specific gravity, etc.).

- Physico-chemical factors (water quality, temperature, reagent types and concentrations, interactions between reagents and particles, etc.).
- Hydrodynamics (flotation circuit design, cell type, aeration rate, spatial distribution of bubbles and particles, etc.)

This plethora of variables makes control of the flotation process an extremely difficult task. As a result. Control usually affected manually by human operators, who base most of their decisions, on the visual appearance of the froth. This often leads to sub- optimal control, owing to factors such as operator inexperience or the inability to act promptly at the first sign of aberrant plant behavior [4].

I. Froth color

Through extraction of the hue, saturation and intensity (HIS), red, green and blue (RGB) or hue, saturation and values (HSV) from color images, the froth color can defined. Useful information on the bubble loading could give by this particularly when the minerals loaded have a distinguishable color [5].

II. Segmentation:

For suitable segmentation to be obtain from using the Watershed Transform on froth images, a certain amount of image preprocessing must performed [5]. The result will be monochrome image (each pixel get either 1, or 0).

III. Bubbles size:

The size of the bubbles is very easy to infer through the ratio (c) of the number of units distributed on the total number of image pixels [6]. The size of the bubbles inversely proportional to the number of ones (1's) distributed in the monochrome image after segmentation. The ratio (c) depends on the accuracy of the camera (resolution), the image size and the distance between the camera and froth.

Centroid Signature

Finding, this signature, by measuring the deviation at the center of a series of quantitative successive images, for one minute at a rate of scene per 2 seconds of time, from the point of origin of the scene. To obtaining the distance between origin pointe $I_{(0,0)}$, and centers of successive scenes. The two-dimensional (p + q)th order moments of a digital shape are defined as [7, 8]:

$$m_{pq} = \sum_x \sum_y x^p y^q I(x,y) \qquad p,q = 0,1,2,\dots \quad (1)$$

The center of mass of the shape then given by

$$x_c = m_{10}/m_{00}\,,\ y_c = m_{01}/m_{00}\,, \quad (2)$$

$$\varphi_i = \sqrt{x_{c_i}^2 + y_{c_i}^2}\,, \qquad i = 1,2,\dots,n\,. \quad (3)$$

Where m the moment, φ_i is a distance, $\left(x_{c_i}, y_{c_i}\right)$ center of image i, and n is a number of scene. Finally, the signature vector will get by dividing φ_i by d_{max}, where, d_{max} diagonal length of image. The fig. 2 – 7 are show the signatures of different images!

IV. Bubble Speed:

The approximate speed (S) of the bubbles in froth, we can get it from the total distances (d) between the centers $\left(x_{c_i}, y_{c_i}\right)$, divided by the total period of the film (T) by $S = d/T$ and the total distances d:

$$d = \sum_{i=2}^{n} \sqrt{\left([(x)]_{c_{i-1}} - x_{c_i}\right)^2 + \left([(y)]_{c_{i-1}} - yx_{c_i}\right)^2}\,. \quad (4)$$

Where n, number of scene.

Result and Discussion

In the search six different sequences of Images for different froth [9, 10], as shown in fig. 2 the signatures they got from them, shown in fig. 3 – 8 respectively.

Through signatures, bubble color, bubble size, and bubble speed, into expert system, to control the system of floatation froth [11]. Therefore, the on-line system must be high speed; this work will decrease the time for pressing, because of mathematical operations is simple and less than others are.

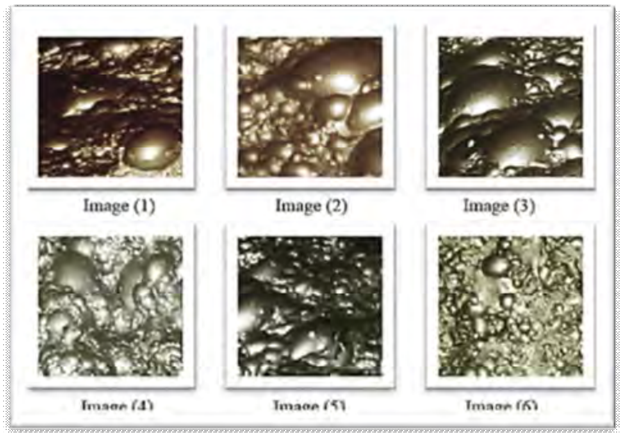

Fig. 2. Show the first Image of six sequences

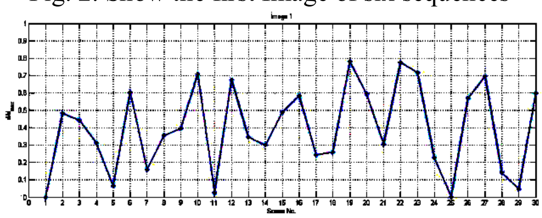

Fig. 3. Signature of sequences image 1

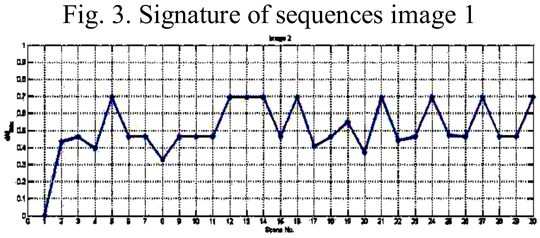

Fig. 4. Signature of sequences image 2

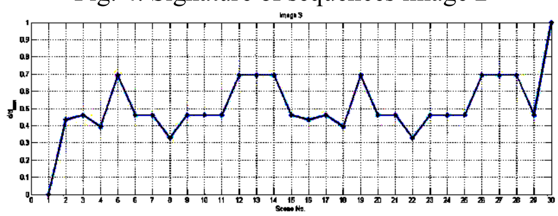

Fig. 5. Signature of sequences image 3

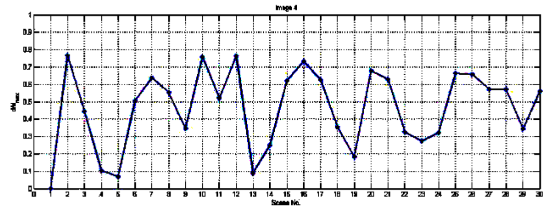

Fig. 6. Signature of sequences image 4

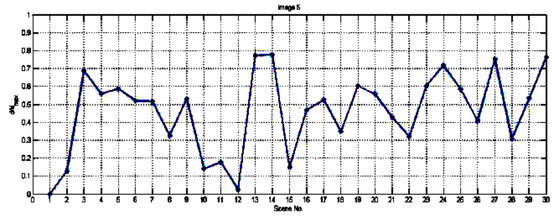

Fig. 7. Signature of sequences image 5

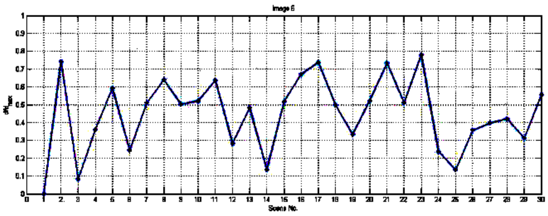

Fig. 8. Signature of sequences image 6

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Рецензент: д-р техн. наук, проф. В.М. Рудницький, Черкаський державний технологічний університет, Черкаси.

КОМП'ЮТЕРНА ВІДЕОСИСТЕМА ДЛЯ ФЛОТАЦІЇ ПІНИ НА БАЗІ CENTROID

Аль-Джанабі Акіл Бахр Таркхан

В багатьох дослідженнях повідомляється про процес управління флотації піни. Використовують класичні математичні методи, наприклад, для знаходження границі об'єкту та виміру розміру, кольору та швидкості бульбашок в флотаційній піні. Але жодне з досліджень обговорювало отримати підписи флотаційної піни, як єдиної частини. За допомогою системи можна управляти станом для прийняття рішення щодо динамічності та коригування процесу флотації, або виправлення помилок, якщо вони є. Метою даного дослідження є обговорення можливості пошуку цього підпису з допомогою вимірювання відхилень центру мас ряду послідовних зображень, за одну хвилину з періодичністю 1 в 2 секунди (30 зображень за хвилину), з точки адреси початку блоку (зображення). Використаний алгоритм на експертній системі є первинною інструкцією, ми можемо побачити стан об'єкта в даний момент та закріпити результати контролюючої системи, яка відповідальна за процес.

***Ключові слова**: комп'ютерна відеосистема, обробка флотації зображення підпису, обробка зображень, флотація.*

КОМПЬЮТЕРНАЯ ВИДЕОСИСТЕМА ДЛЯ ФЛОТАЦИИ ПЕНЫ НА БАЗЕ CENTROID

Аль-Джанаби Акил Бахр Таркхан

Во многих исследованиях сообщается о процессе управления флотации пены. Используют классические математические методы, например, для нахождения границы объекта и измерения размера, цвета и скорости пузырьков в флотационной пене. Но ни одно из исследований не обсуждало получение подписи флотационной пены, как единственной части. С помощью системы можно управлять состоянием для принятия решения относительно динамичности и коррекции процесса флотации, или исправления ошибок, если они есть. Целью данного исследования является обсуждение возможности поиска этой подписи с помощью измерения отклонений центра масс ряда последовательных изображений, за одну минуту с периодичностью 1 в 2 секунды (30 изображений за минуту), из точки адреса начала блока (изображение). Использованный алгоритм на экспертной системе является первичной инструкцией, мы можем увидеть состояние объекта в данный момент и закрепить результаты контролирующей системы, ответственной за процесс.

***Ключевые слова**: компьютерная видеосистема, обработка флотации изображения подписи, обработка изображений, флотация.*