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Mathematical morphology image processing and reconstruction technology application in sprint competition video processing

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ABSTRACT

In the fierce sprint competition videos, it contains lots of kinematics data, these data has very important significances in researching on athletes' sports rules, however how to extract lots of data from videos is a big puzzle. The paper applies mathematical morphology-based metallographic image edge detection algorithm into sprint competition videos, extracts lots of valuable kinematics data. Firstly, the paper introduces mathematical morphology basic theories, and then researches on edge detecting relative theories, finally combines with mathematical morphology and edge detection relative knowledge to apply into sprint competition videos, extracts data from competition videos, which builds data basis for researching 100 meters running kinematics rules.

KEYWORDS

Mathematical morphology;
Edge extraction;
Image processing and reconstruction;
Kinematics data;
Video processing.

INTRODUCTION

With computer technology and digital image processing technology rapidly development, monitoring videos' effects are constantly increasing, people not only can extract visual information from videos, but also can extract more digital information, the paper applies such digital information extracting method by processing with video images into 100 race, with an aim to extract athletes' kinematics data, so that provides more scientific and reasonable training ways and propels to our country athletes' levels advancement.

For image processing and reconstruction technology, lots of predecessors have made efforts, just these scholars' unremitting efforts, it let image processing and reconstruction technology to be rapidly developed, and widely applied into all walks of life. Among them, Yuan Ting-Gang (2003) in the article "First exploration of Image processing technology application in athletics scientific research" pointed out that image collecting, getting, coding, storing and transportation, images composition and generation, image indication and output, image transformation, strengthen, recovery (restoration) and construction, image segmentation, objective detection, expression and description, features extracting and measurement, sequential image correction and others had widely application values in athletics scientific researches on competition videos image researching, was an important way in future researching on sports events[1]. Jiang Ai (2010) applied image segmentation and reconstruction algorithm into human body foot skeleton research, which made important contributions to human body foot skeleton research. Huang Ying (2012)in the article "Graph theory-based image processing and object identification algorithm research", she pointed out that used algebra multiple gridding extracted coarse grids reconstruction result to make features expression could effective improve corresponding features' contrast ratio, improve discriminating ability, which made great contributions to graph theory image processing technology[3].

The paper on the basis of previous research, applies image processing and reconstruction technology into sprint videos, extracts lots of kinematics data, with an aim to provide data basis for researching our country athletes' physical ability and biological motion law, so that speeds up our country sports development.

MATHEMATICAL MORPHOLOGY BASIC THEORY

Mathematical morphology is established on the basis of strict mathematics theory, is a branch of applied mathematics, its theoretical basis is set theory and geometry as well as other mathematics theories, which contains random set theory, topology, integral geometry, probability, graph theory and so on, according to set theory knowledge, mathematical morphology researched is a computational method from one set to another set, by some computing rules, let two sets data to have one-to-one correspondence, so that get object more essential features, apply the thought into image processing, it will produce mathematical morphology-based image output and analysis theory as well as methods. Mathematical morphology metallographic image edge detection algorithm is one theory and method of them.

Structural element and multistage multiple structural element

Computing object in mathematical morphology is set, propose that A is image set, B is structural element, mathematical morphology is using structural element B to operate with image A. When structural element is moving in the images, it can detect image each part relations, taking useful features and information and arriving at the purpose of image analysis and processing. Therefore, result elements selection should follow below two principles:

(1) In geometry, the simpler structural element is, the better would be, and structural element is far simpler than original image and has boundaries.

(2) In the shape, to structural element, to possess some convexity features, such as can select round, square and other structural elements.

Binary morphology four kinds of basic computation

Binary morphology four kinds of basic computation is as following text formula(1), (2), (3), (4), firstly define set A, B are nonempty sets, $A_b = \{y | y = x + b, x \in A\}$ is got after set A translating b, set $\overline{A} = \{y | y = -x, x \in A\}$ is the reflection of set A, then it has:

1. As a result of A is expanded by B:

$$\mathbf{A} \oplus \mathbf{B} = \bigcup_{b \in B} \mathbf{A}_b = \{x | [(\mathbf{B})_x \cap \mathbf{A}] \neq \Phi\} = \left\{x \middle| \exists_{b \in B} (x = a + b)\right\} \quad (1)$$

2. As a result of A is got corrosion by B:

$$\mathbf{A \Theta B} = \left(\mathbf{A}^c \oplus \hat{\mathbf{B}}\right)^c = \{x | \mathbf{B}_x \subseteq \mathbf{A}\} \quad (2)$$

3. As a result of A is opened by B:

$$\mathbf{A} \circ \mathbf{B} = (\mathbf{A \Theta B}) \oplus \mathbf{B} \quad (3)$$

4. As a result of A is closed by B:

$$\mathbf{A} \bullet \mathbf{B} = (\mathbf{A} \oplus \mathbf{B}) \Theta \mathbf{B} \quad (4)$$

Binary image f suffered structural element b expansion, corrosion, opening and closure process is as Figure 1 show, from which Figure 1—a shadow part represents binary image f, Figure 2—b shadow parts represents structural element B, according to Figure 1, it is clear that expansion result is expanding original image areas, corrosion result is shrinking original image areas.

Expressive meaning of each letter in Figure1 is as following TABLE 1 show (and has same meanings as

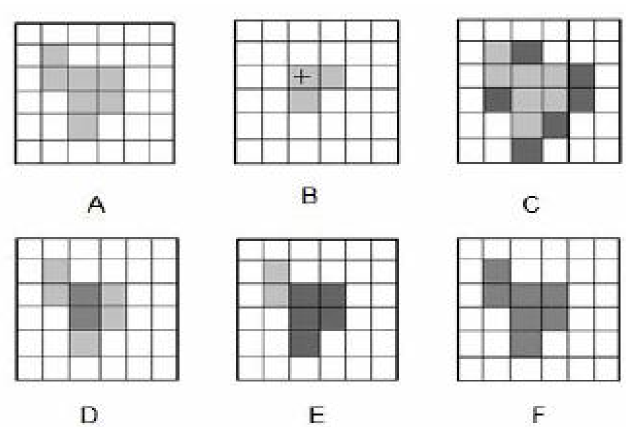

Figure 1 : Binary image basic computing process

following text in Figure 2, 3, 4).

Metallographic binary image f suffered structural element B expansion, corrosion, opening and closure effect figures are as Figure 2shows.

TABLE 1 : Symbol meaning

A	Original metallographic binary image	D	Corrosion result
B	Structural element	E	Opening result
C	Expansion result	F	Closure result

By Figure 2, it is clear that binary opening computation turns original image's lunge into round, it can filter convex angle that is smaller than structural element, cut down slim lap joint and play segmentation roles; and closure computation turns original image concave angle into round, which can fill with gap or hole that is smaller than structural element, joint short interruption and play connecting roles. All of them can eliminate specified image details that are smaller than structural element, and meanwhile ensure it will not generate global geometric distortion.

Gray scale morphology four kinds of basic computation

Set f is input image, domain of definition is D_f, b is structural element, domain of definition is D_b. Then it has:

As a result of image f is expanded by b :

$$(f \oplus b)(s,t) = \max_{\substack{(s-x,t-y)\in D_f \\ (x,y)\in D_b}} \{f(s-x,t-y)+b(x,y)\} \quad (5)$$

As a result of image f is got corrosion by b :

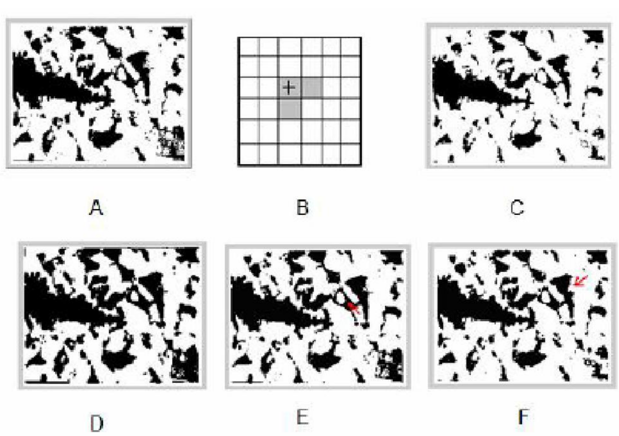

Figure 2 : Metallographic binary image basic computational effects

$$(f\Theta b)(s,t) = \min_{\substack{(s+x,t+y)\in D_f \\ (x,y)\in D_b}} \{f(s+x,t+y)-b(x,y)\} \quad (6)$$

As a result of image f is opened by b :

$$f \circ b = (f\Theta b)\oplus b \quad (7)$$

As a result of image f is closed by b :

$$f \bullet b = (f \oplus b)\Theta b \quad (8)$$

Metallographic gray scale image f suffered structural element b expansion and corrosion process is as Figure 3 shows.

By Figure 3, it is clear that expansion result is expanding original image area, it let shiny background parts to be expanded, dark background parts to be shrunk, and corrosion result is shrinking original image area, let dark background parts to be expanded, shiny background parts to be shrunk. Its computation effect figure is as Figure 4 shows.

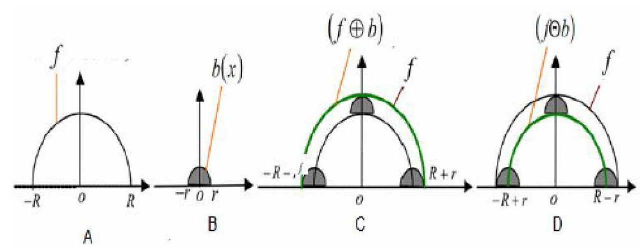

Figure 3 : Metallographic gray scale image expansion and corrosion computational process

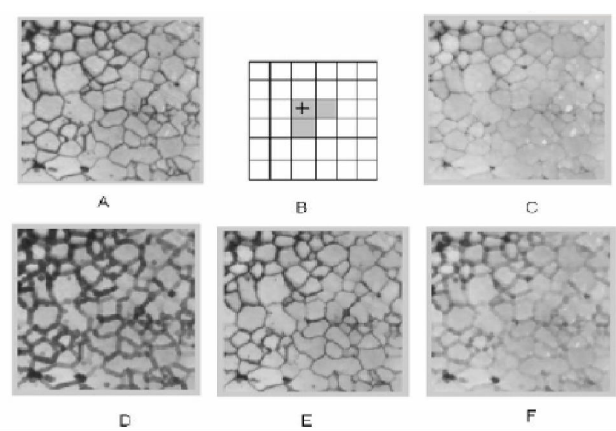

Figure 4 : Metallographic gray scale image basic computation effects

MATHEMATICAL MORPHOLOGY-BASED METALLOGRAPHIC IMAGE EDGE DETECTION PRINCIPLE

Mathematical morphology-based metallographic image processing principle is simple and perfect, and can eliminate swimming competitions' water interference, which adapts to swimming competition videos data correct extracting, mathematical morphology utilizes structural elements to detect every metallographic image, regard metallographic image as set. The set is a set that can translate in metallographic images and its size is smaller than metallographic image. Basic mathematical morphology computation refers to computation that transforms from a set to another set, and meanwhile makes intersection, combination and supplementation as well as other basic set computations with metallographic image that as set, and further extract metallographic image useful information and features. Its image processing flow chart Is as Figure 5 shows.

Several kinds of basic metallographic image morphology edge detection operator

Set $f(x, y)$ is gray scale function that is defined in R^2 or Z^2, $b(x, y)$ is structural element that is defined in R^2 or Z^2, then it can get following kinds of morphology edge detection operator:

Expansion type:

$$\mathbf{I_1 = (f \oplus b) - f} \quad (8)$$

Corrosion type:

$$\mathbf{I_2 = f - (f \Theta b)} \quad (9)$$

Expanding corrosion type:

$$\mathbf{I_3 = (f \oplus b) - (f \Theta b)} \quad (10)$$

Opening type:

$$\mathbf{I_4 = f - (f \circ b)} \quad (11)$$

Closure type:

$$\mathbf{I_5 = (f \bullet b) - f} \quad (12)$$

Opening closure type:

$$\mathbf{I_6 = (f \bullet b) - (f \circ b)} \quad (13)$$

Noise proof expansion combinative type:

$$\mathbf{I_7 = (f \oplus b) - (f \bullet b)} \quad (14)$$

By above formula, it is clear that morphology edge extraction operator is a kind of nonlinear difference operator, and extracted edge is related to structural element $b(x, y)$. Therefore, mathematical morphology has been more and more widely applied in metallographic image processing and analysis especially in metallographic image edge detection. It has already deepened

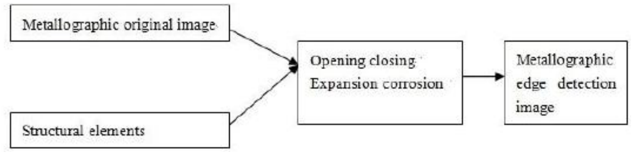

Figure 5 : Basic thought of mathematical morphology metallographic image edge detection edge is related to structural element $b(x, y)$. Therefore, mathematical morphology has been more and more

into all walks of life.

Multiscale and multiple structure element-based metallographic image edge detection algorithm

Metallographic image internally tends to have more impurities; therefore it needs to remove uncorrelated particle structures, so that let image effective data to more prominent. Its algorithm flow chart is as following Figure 6.

Among them, threshold value 1 takes metallographic image gray scale histogram doublet valley point or inflection point, threshold value 2 is solved by using iterative approach method that is to take maximum gray value and minimum gray value's arithmetic average $\frac{\delta_{\min} + \delta_{\max}}{2}$ as initial value L_0, then segment image, respectively calculate S_1, S_2 average gray value, assume they are δ_1 and δ_2, and then take their average value as new threshold value, subsequently segment image ……, circulate in this way until new threshold value to be unchanged. Among them, Figure 6 threshold value solv-

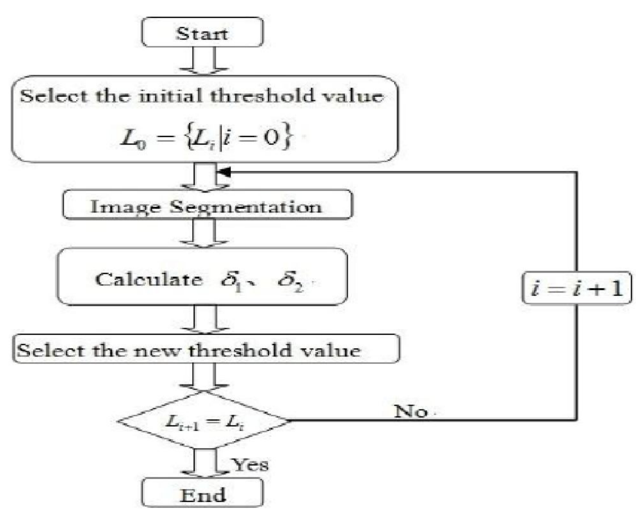

Figure 6 : Multiscale and multiple structure elements-based metallographic image edge detection algorithm flow

ing used formula is as following:

$$L_0 = \{L_i | i = 0\} = \frac{\delta_{min} + \delta_{max}}{2} \quad (17)$$

$$S_1 = \{f(x,y) | f(x,y) \geq L_i\} \quad (18)$$

$$S_2 = \{f(x,y) | 0 \leq f(x,y) < L_i\} \quad (19)$$

$$\delta_1 = \frac{\sum_{f(s,t) \geq L_i} f(x,t) \times N(s,t)}{\sum_{f(s,t) \geq L_i} N(s,t)} \quad (20)$$

$$\delta_2 = \frac{\sum_{f(s,t) < L_i} f(x,t) \times N(s,t)}{\sum_{f(s,t) < L_i} N(s,t)} \quad (21)$$

CONCLUSION

The paper briefly states mathematical morphology basic theories, and combines with metallographic edge detection method to apply mathematical morphology-based metallographic image edge detection algorithm into sprint competition videos, extracts competition videos lots of valuable data. For the edge detection algorithm, it makes experiment and proves the algorithm is obviously superior to traditional edge detection method; it has better noise proof functions, more correct extracted edge, better continuousness and smoothness advantages than traditional edge detection method. The paper applies mathematical morphology-based metallographic image edge detection algorithm into sports events' competition videos, which provides a kind of new method for researching biological motion laws, and opens up a new path for future sports events researching.

REFERENCES

[1] Huang Yin hua, Ouyang Liu qing, Kang Chang fa et al.; On the Chinese soccer fan culture. Journal of Wuhan Institute of Physical Education, **36(6)**, 7-9 **(2002)**.

[2] Lin Zi-yong; A Discussion on the Chinese Football Fans in Cultural Perspective. Sports Sciences Researches, **9(2)**, 44-49 **(2005)**.

[3] Fu Dao-hua, Zhang Pei-zhi, Meng Xian-lin; Study on Economic Culture Function of Soccer Fans and Factors of Aberration Actions and Prevention Measurements. China Sport Science and Technology, **42(6)**, 33-37 **(2006)**.

[4] Bi Bo; The Analyzes to Basic Integrant Part of The Soccerfan Culture's Connotation. Sports & Science, **28(5)**, 68-70, 67 **(2007)**.

[5] Liu Kai; Analysis of Soccer Globalization on World Soccer Sports Development. Bulletin of Sport Science & Technology, **16(12)**, 18-20 **(2008)**.

[6] Zhao Gui-sheng, Han Xin-jun, Chen Jian-sheng, Xie Lun-li, Suo Yan-jun, Hu Xiao-hua; Reason Analysis and Countermeasures on Misbehavior of Football Fans. Bulletin of Sport Science & Technology, **19(2)**, 10-12 **(2011)**.

[7] Zhou Xiujun, Mao Zhichen; The Deviant Behavior Classification and the Trend Analysis of Chinese Soccer Fans on the Soccer Field. Sports & Science, **32(6)**, 103-106 **(2011)**.