Review Paper Multilevel Thresholding Selection Based on the Artificial Bee Colony Algorithm for Image Segmentation

Randy Kusuma Putra
Departemen Ilmu Komputer dan Elektronika Instrumentasi
Universitas Gadjah Mada
Yogyakarta, Indonesia
randy.kusuma.p@mail.ugm.ac.id

***Abstract*— Lorem ipsum dolor sit amet, consectetur adipiscing elit. Curabitur sapien dui, mollis id tincidunt a, dictum eleifend risus. Praesent iaculis mattis rutrum. Fusce feugiat nisl ac leo hendrerit sollicitudin. Fusce commodo dolor convallis pretium sodales. Donec feugiat nisi ut risus vestibulum consequat. Phasellus vitae sapien et dolor euismod vehicula vitae sit amet dolor. Mauris scelerisque iaculis arcu, at tempor nibh sodales eget. Maecenas nec laoreet lorem. Maecenas ultrices convallis ex, non cursus metus vestibulum nec. Phasellus sagittis aliquam velit ut elementum. Integer a orci nisi. Proin eu tortor a erat condimentum condimentum sit amet vitae lectus. Integer tristique ante eget facilisis interdum. Cras egestas, tellus non condimentum bibendum, nulla justo consequat quam, at gravida ipsum sem at tellus. Phasellus consectetur turpis enim, sed tempor ipsum tincidunt et. Morbi id tristique libero.**

Keyword : ABC, MEABCT, Maksimum Entropy ABC

I. INTRODUCTION

Thresholding adalah teknik yang paling penting dalam proses *image segmentation*. Tujuannya adalah menentukan ambang batas untuk bi-level atau beberapa ambang multi level untuk proses *image segmentation*. Secara umum, metode untuk penentuan ambang batas global dapat dikategorikan menjadi parametrik dan non-parametrik. Pada pendekatan parametrik, distribusi tingkat abu-abu dari setiap kelas mempunyai probabilitas fungsi kepadatan yang mengikuti distribusi Gaussian. Pendekatan dengan metode parametrik akan mempekirakan parameter distribusi yang cocok dengan data dari histogram. Kittler and Illingworth (1986) mengusulkan metode thresholding yang mendekati histogram dengan campuran distribusi normal dan meminimalkan kesalahan klasifikasi probabilitas [1]. Zahara, Fan, and Tsai (2005) mempresentasikan skema pengoptimalan hibrida untuk beberapa ambang dengan kriteria varian minimum dalam kelas Otsu dan pemasangan fungsi Gaussian [2]. Wang, Chung, and Xiong (2008) mengusulkan metode yang berakar pada perkiraan jendela Parzen dari fungsi kepadatan nilai abu-abu yang tidak diketahui. Metode ini dapat mengintegrasikan informasi histogram gambar dengan informasi spasial tentang piksel dari berbagai tingkat abu-abu [3].

Pendekatan non-parametrik akan mencari ambang batas yang memisahkan daerah tingkat abu-abu dari gambar secara optimal berdasarkan kriteria yang membedakan, seperti *between-class variance, entropy and cross entropy*. Metode yang popular adalah *Otsu's method* (1979), memilih nilai batas ambang dengan memaksimalkan perbedaan nilai antar kelas [4]. Shoo, Soltani, Wong, and Chen (1988) menemukan bahwa metode Otsu lebih baik dalam menentukan ambang batas untuk gambar dunia nyata berkaitan dengan ukuran keseragaman dan bentuk. Namun, formulasi antar-kelas yang tidak efisien dan metode ini memakan waktu yang lama dalam pemilihan ambang atas untuk multilevel [5]. Untuk memecahkan permasalahan ini, Liao, Chen, and Chung (2001) mengusulkan algoritma rekursif yang cepat, *Fast Otsu's method* bersamaan dengan *look-up-table* untuk mengimplementasikan pada *multilevel thresholding* [6]. Kapur, Sahoo, and Wong (1985) proposed a method for gray-level picture thresholding using the entropy of the histogram [7]. Abutaleb (1989) proposed a 2-D maximum entropy thresholding method for separating the regions of image. Li and Lee (1993) proposed a method which selects the threshold by minimizing the cross entropy between the original and segmented images [8]. Zhang and Liu (2006) adopted the particle swarm optimization algorithm to maximize the entropy for underwater image segmentation [9]. Ye, Chen, Li, and Zhang (2008) proposed a particle swarm optimization (PSO) algorithm to optimize the Otsus criterion [10]. Madhubanti and Amitava (2008) proposed a hybrid cooperative-comprehensive learning based PSO algorithm (HCOLPSO) based on maximum entropy criterion [11]. Yin (2007) developed a recursive programming techniques to reduce the order of magnitude of computing the multilevel thresholds and further used the PSO algorithm to minimize the cross entropy [12]. Horng (2010) applied the honey bee mating optimization (HBMO) to search for the thresholds of histogram of image [**?**]. The developed method was called maximum entropy honey bee mating optimization (MEHBOT) algorithm. The experimental results demonstrated that the result of the MEHBOT algorithm was superior to other algorithms such as the PSO, HCOLPSO and Fast Otsus methods.

Selama dekade terakhir, permodelan dengan menggunakan kebiasaan serangga sosial, seperti semut dan lebah, untuk tujuan pencarian dan pemecahan masalah telah menjadi konteks dari *swarm intelligence*. Algoritma *Artificial Bee Colony* dianggap sebagai pendekatan secara *swarm* untuk pengoptimalan, yang dimana algoritma pencarianya terinspirasi dari kawanan lebah. Pada algoritma pencari terdapat tiga komponen yang penting, yaitu : sumber makanan, mempekerjakan pekerja, dan penganggur selama bertahun-tahun. Ada dua mode yang digunakan di dalam algoritma ini, yaitu : mengerahkan menuju dan meninggalkan sumber makanan. Pekerja yang menganggur sebagai pengintai dan *onlooker*.

Paper ini menggunakan algoritma ABC untuk mencari batas ambang multilevel menggunakan kriteria *Maximum Entropy* (MET). Metode yang diusulkan ini dinamakan algoritma *maximum entropy based artificial bee colony thresholding* (MEABCT). Eksperimen yang disajikan pada paper ini, metode pencarian lengkap dilakukan untuk mendapatkan hasil yang optimal untuk perbandingan dengan hasil dari algoritma MEABCT. Empat metode yang diimplementasikan adalah PSO, algoritma *hybrid cooperative-comprehensive learning based PSO* (HCOCLPSO), metode *Fast Otsu*, dan MEHBMOT pada beberapa gambar dunia nyata sebagai perbandingan.

II. Artificial Bee Colony Algorithm

Di dalam algoritma *Artificial Bee Conlony* ada tiga kelompok lebah, yaitu : pekerja, *onlooker*, dan pengintai. Lebah pekerja yang membawa nektar dari sumber makanan menuju ke sarang dan berbagi informasi tentang sumber makanan di area berdansa. Lebah-lebah ini membawa informasi tentang sumber makanan dengan probabilitasnya dibagikan dengan berdansa di area dansa dalam sarang. Lebah *onlooker* akan menunggu di area dansa untuk mengambil keputusan dari pilihan sumber makanan berdasarkan probabilitasnya yang diantarkan oleh lebah pekerja. Penghitungan probabilitas berdasarkan banyaknya sumber makanan yang tersedia. Sedangkan lebah pengintai akan melakukan pencarian untuk sumber makanan yang baru, lebah pekerja yang berada disumber makanan yang telah ditinggalkan akan menjadi lebah pengintai yang akan mencari sumber makanan yang baru, segera setelah menemukan sumber baru maka lebah pengintai tersebut akan menjadi lebah pekerja lagi. Dengan kata lain, algoritma ABC berisi tiga langkah. Pertama lebah pekerja akan dikirim ke sumber makanan, dan membawa makanannya pulang dan membagikan informasi tentang nektar yang ada pada sumber makanan tersebut. Setelah membagikan informasi ini, lebah *onlooker* akan memilih sumber makanan dan mengevaluasi banyaknya nektar yang ada disumber. Lalu lebah pengintai akan dipilih dan ditugaskan untuk mencari sumber-sumber makanan yang baru.

Algoritma *Aritifial Bee Colony* diusulkan oleh Karaboga and Basturk (2008) [7].

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$$\alpha + \beta = \chi \tag{1}$$

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TABLE I
AN EXAMPLE OF A TABLE

One	Two
Three	Four

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Fig. 1. Inductance of oscillation winding on amorphous magnetic core versus DC bias magnetic field

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V. CONCLUSIONS

A conclusion section is not required. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

APPENDIX

Appendixes should appear before the acknowledgment.

ACKNOWLEDGMENT

The preferred spelling of the word acknowledgment in America is without an e after the g. Avoid the stilted expression, One of us (R. B. G.) thanks . . . Instead, try R. B. G. thanks. Put sponsor acknowledgments in the unnumbered footnote on the first page.

References are important to the reader; therefore, each citation must be complete and correct. If at all possible, references should be commonly available publications.

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