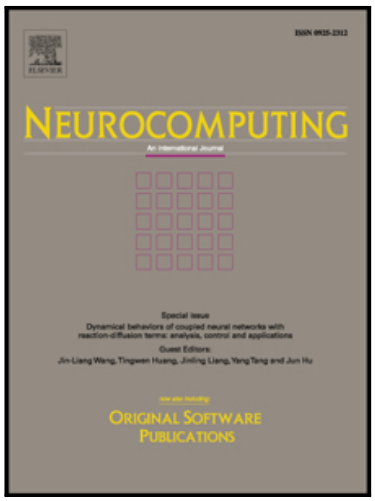

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Fabian Boemer, Edward Ratner, Amaury Lendasse

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Parameter-Free Image Segmentation with SLIC

Fabian Boemer[a], Edward Ratner[a], Amaury Lendasse[b,c,d]

[a] *Lyrical Labs, Iowa City, USA*
[b] *Department of Mechanical and Industrial Engineering, The University of Iowa, Iowa City, USA*
[c] *The Iowa Informatics Initiative, The University of Iowa, Iowa City, USA*
[d] *Risklab at Arcada University of Applied Sciences, Helsinki, Finland*

Abstract

In this paper, we develop a parameter-free image segmentation framework using Simple Linear Iterative Clustering (SLIC) and Extreme Learning Machines (ELM). SLIC requires a single parameter, the number of centroids k. Our framework, called PF-SLIC (Parameter-Free SLIC) uses an ELM to predict the optimal k, generating a parameter-free framework. PF-SLIC and its streaming variant SPF-SLIC (Streaming PF-SLIC) achieve performance comparable to other models on ultra-high-definition (4K) images and streams, with runtimes orders of magnitude lower.

Keywords: SLIC, ELM, image segmentation, superpixel, streaming

1. Introduction

The goal of image segmentation is to partition an image with N pixels into disjoint sets of pixels called clusters. Image segmentation has been widely applied in machine vision [1], medical applications [2], and video compression [3]. Existing image segmentation algorithms are based on artificial neural networks, partial differential equations, edge-detection, fuzzy theory, region-detection, and thresholds [4]. While many of these approaches yield reasonable segmentations, they are often slow [5] and therefore computationally intractable for large images.

One way to counteract computational infeasibility is through a pre-processing step called superpixel segmentation. Superpixel segmentation is a sub-problem of image segmentation with the goal of representing an image accurately using a smaller number of pixels, called superpixels. Desired properties of superpixels depend on specific application, but may include adherence to image boundaries, computational efficiency, and improvement of subsequent image processing [6; 7]. Efficient superpixel segmentation is important in processing large images, especially in the realm of ultra-high-definition ($N = 3840 \times 2160$) resolution.

A downside to many superpixel segmentation algorithms is the need for parameter tuning, which can greatly reduce the practical efficiency of the algorithm. Turbopixels [8] and SLIC [6], for instance, have a single parameter

Email addresses: Fabian.boemer@lyricallabs.com (Fabian Boemer), ed.ratner@lyricallabs.com (Edward Ratner), amaury-lendasse@uiowa.edu (Amaury Lendasse)