Evenness-controllable point cloud simplification based on graph

Anonymous VCIP Submission
Paper ID:

***Abstract*—keep sharp features like edges while keep the evenness of points**

***Index Terms*—Include at least 5 keywords or phrases**

I. Introduction

what's simplification and what's the meaning of it

II. Related Work

A. Point Cloud Simplification

what's done
advantages and disadvantages

- Top = 19mm (0.75")
- Bottom = 43mm (1.69")
- Left = Right = 14.32mm (0.56")

B. Graph Signal Processing

what's GSP and how to construct graph

III. Problem Formulation

Here, we describe point cloud simplification as a process of resampling of the point cloud: given a point cloud P with $|P| = N$, find a point cloud $P' \subset P$ with $|P'| = M < N$.

For convenience, we represent the point cloud with N points and K attributes as $X \in \mathbb{R}^{N \times K}$, where ith row represents the ith point, represented as x_i^T. Attributes can be coordinates, colors and others, $K \geq 3$. To represent the simplified point cloud, we consider the diagonal matrix Ψ, called resampling matrix with $\Psi_{ii} = 1$ if x_i in the simplified point cloud and $\Psi_{ii} = 0$ if not. Thus, the simplified point cloud can be represented as ΨX.

Our goal is to find the optimal resampling matrix Psi to keep most geometry features of the point cloud while keep the evenness. Inspired by Chen[], we use graph filter to extract features of point cloud and select points with higher features. We use the random walk Laplacian $L_0 = D^{-1}L = I - D^{-1}W$ to extract features, which is a high-pass graph filter keeping sharp features. Thus, we can represent features of point cloud X as L_0X and the remaining features (of the simplified point cloud) as $\Psi L_0 X$. Now we define the feature loss of simplification as $l_f = \Psi L_0 X - L_0 X$.

However, merely using random walk Laplacian will cause the unevenness of point cloud because edges with sharp features will be saved sound while the surfaces will be neglected, which will cause extreme unevenness. To avoid this extreme unevenness, we define a evenness term to control the evenness of the simplified point cloud.

When constructing the graph, we select points within radius r as point's neighbour. If we suppose the point cloud is even, the number of neighbours of each point should be approximately equal and thus, we can use k-nearest neighbours.

An example of a bad paper:

> An analysis of the frobnicatable foo filter.
> In this paper we present a performance analysis of our previous paper [1], and show it to be inferior to all previously known methods. Why the previous paper was accepted without this analysis is beyond me.
> [1] Removed for blind review

IV. Page Style

All paragraphs must be indented. All paragraphs must be justified, i.e. both left-justified and right-justified.

A. Text Font of Entire Document

The entire document should be in Times New Roman or Times font. Type 3 fonts must not be used. Other font types may be used if needed for special purposes.

Recommended font sizes are shown in Table I.

B. Title and Author Details

Title must be in 24 pt Regular font. Author name must be in 11 pt Regular font. Author affiliation must be in 10 pt Italic. Email address must be in 9 pt Courier Regular font.

All title and author details must be in single-column format and must be centered.

TABLE I
FONT SIZES FOR PAPERS

Font Size	Appearance (in Times New Roman or Times		
	Regular	**Bold**	**Italic**
8	table caption (in Small Caps), figure caption, reference item		reference item (partial)
9	author email address (in Courier), cell in a table	abstract body	abstract heading (also in Bold)
10	level-1 heading (in Small Caps), paragraph		level-2 heading, level-3 heading, author affiliation
11	author name		
24	title		

Every word in a title must be capitalized except for short minor words such as “a”, “an”, “and”, “as”, “at”, “by”, “for”, “from”, “if”, “in”, “into”, “on”, “or”, “of”, “the”, “to”, “with”.

Author details must not show any professional title (e.g. Managing Director), any academic title (e.g. Dr.) or any membership of any professional organization (e.g. Senior Member IEEE).

To avoid confusion, the family name must be written as the last part of each author name (e.g. John A.K. Smith).

Each affiliation must include, at the very least, the name of the company and the name of the country where the author is based (e.g. Causal Productions Pty Ltd, Australia).

Email address is compulsory for the corresponding author.

C. Section Headings

No more than 3 levels of headings should be used. All headings must be in 10pt font. Every word in a heading must be capitalized except for short minor words as listed in Section IV-B.

1) Level-1 Heading: A level-1 heading must be in Small Caps, centered and numbered using uppercase Roman numerals. For example, see heading “IV. Page Style” of this document. The two level-1 headings which must not be numbered are “Acknowledgment” and “References”.

2) Level-2 Heading: A level-2 heading must be in Italic, left-justified and numbered using an uppercase alphabetic letter followed by a period. For example, see heading “C. Section Headings” above.

3) Level-3 Heading: A level-3 heading must be indented, in Italic and numbered with an Arabic numeral followed by a right parenthesis. The level-3 heading must end with a colon. The body of the level-3 section immediately follows the level-3 heading in the same paragraph. For example, this paragraph begins with a level-3 heading.

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Figures and tables must be centered in the column. Large figures and tables may span across both columns. Any table or figure that takes up more than 1 column width must be positioned either at the top or at the bottom of the page.

Graphics may be full color. All colors will be retained on the CDROM. Graphics must not use stipple fill patterns because they may not be reproduced properly. Please use only SOLID FILL colors which contrast well both on screen and on a black-and-white hardcopy, as shown in Fig. 1.

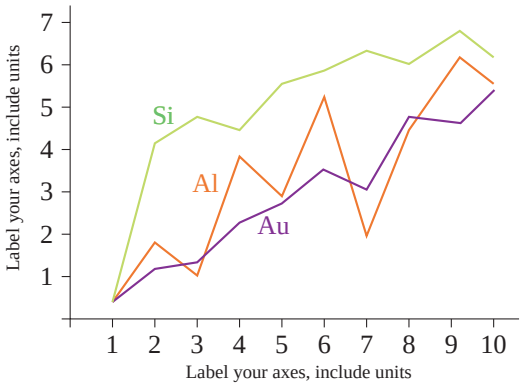

Fig. 1. A sample line graph using colors which contrast well both on screen and on a black-and-white hardcopy

Fig. 2 shows an example of a low-resolution image which would not be acceptable, whereas Fig. 3 shows an example of an image with adequate resolution. Check that the resolution is adequate to reveal the important detail in the figure.

Please check all figures in your paper both on screen and on a black-and-white hardcopy. When you check your paper on a black-and-white hardcopy, please ensure that:

- the colors used in each figure contrast well,
- the image used in each figure is clear,
- all text labels in each figure are legible.

Fig. 2. Example of an unacceptable low-resolution image

E. Figure Captions

Figures must be numbered using Arabic numerals. Figure captions must be in 8 pt Regular font. Captions of a single line (e.g. Fig. 2) must be centered whereas multi-line captions

Fig. 3. Example of an image with acceptable resolution

must be justified (e.g. Fig. 1). Captions with figure numbers must be placed after their associated figures, as shown in Fig. 1.

F. Table Captions

Tables must be numbered using uppercase Roman numerals. Table captions must be centred and in 8 pt Regular font with Small Caps. Every word in a table caption must be capitalized except for short minor words as listed in Section IV-B. Captions with table numbers must be placed before their associated tables, as shown in Table I.

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Page numbers, headers and footers must not be used.

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All hypertext links and section bookmarks will be removed from papers during the processing of papers for publication. If you need to refer to an Internet email address or URL in your paper, you must type out the address or URL fully in Regular font.

I. References

The heading of the References section must not be numbered. All reference items must be in 8 pt font. Please use Regular and Italic styles to distinguish different fields as shown in the References section. Number the reference items consecutively in square brackets (e.g. [**?**]).

When referring to a reference item, please simply use the reference number, as in [**?**]. Do not use Ref. [**?**] or Reference [**?**] except at the beginning of a sentence, e.g. "Reference [**?**] shows ". Multiple references are each numbered with separate brackets (e.g. [**?**], [**?**], [**?**]–[6]).

Examples of reference items of different categories shown in the References section include:

- example of a book in [**?**]
- example of a book in a series in [**?**]
- example of a journal article in [**?**]
- example of a conference paper in [**?**]
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V. Conclusion

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Causal Productions wishes to acknowledge Michael Shell and other contributors for developing and maintaining the IEEE LaTeX style files which have been used in the preparation of this template.

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