Writing the Paper

Theory, algorithms, experiments, conclusions, *etc.*

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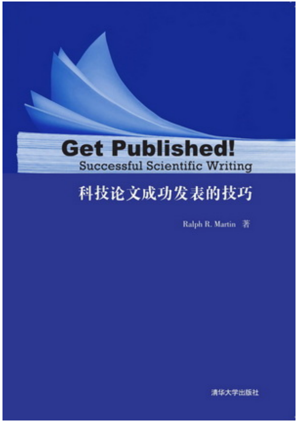

Fig.: Sections 3.6-3.10.

Theory

- A formal statement of the theorem or result itself.
- Describe how the results fits into the overall solution.
  - A sub-problem goal that is addressed by the result.
- A proof or other reasoning to validate the results.

Be readable after remove equations!

Theory: explain with examples

Some people may learn well from theoretical arguments, but others learn better from examples.

- Helpful to give some simple examples to show how the theory works in practice.
- Give readers confidence that they understand your idea, and the idea actually works.

Not just equations, but also explain what your approach is

- What the equation mean.
- Why the equation take the form they do.

Theory: Example

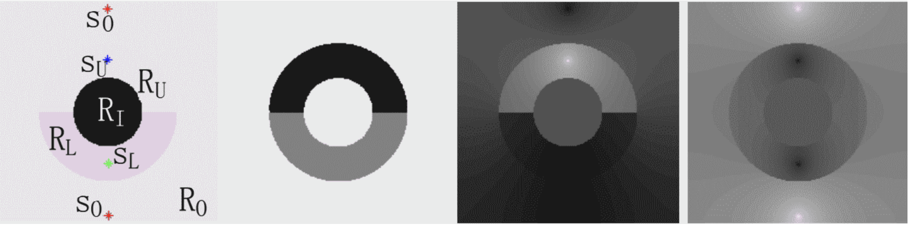

Fig.: A counterexample: (a) input image containing four regions and four seeds of three types; (b) random walk segmentation result; probability of a random walk starting at each pixel first reaching seed type (c) s_U or (d) s_O.

A property suggested by [Grady 06] is that each segmented region is guaranteed to be connected to one or more seeds with that region's label: Isolated regions without seeds do not occur.

Connectedness of Random Walk Segmentation, IEEE TPAMI 2011.

Theory: Example

To show this, we analyze the random walk problem using an equivalent electrical circuit network. We further assume that the algorithm works on general graphs, and generalize the segmentation problem to a special convex hull partition problem (Observ. 1). Then we show, step by step (Propos. 1-5), that for any segmented graph which satisfies the connectedness property and has more than three label types, even allowing the algorithm to have more general weighting (Propos. 4) and assignment rule (Propos. 5), it is still possible to replace some part of it in a way which makes the connectedness property fail. Finally, Proposition 5 provides a condition under which random walk segmentation is guaranteed to give a connected result.

Connectedness of Random Walk Segmentation, IEEE TPAMI 2011.

Theory: Example

Proposition 2. *For any H satisfying Proposition 1, we can construct a PSN with conductance matrix H.*

Proof. The proof is simple—we just connect boundary nodes. For boundary nodes i and j, we add an edge with weight (conductance) $-h_{ij}$. It is easy to check that the conductance matrix is H. Note that no inner nodes are created, and such a matrix corresponds to C in the proof of Proposition 1. □

Connectedness of Random Walk Segmentation, IEEE TPAMI 2011.

Theory: Example

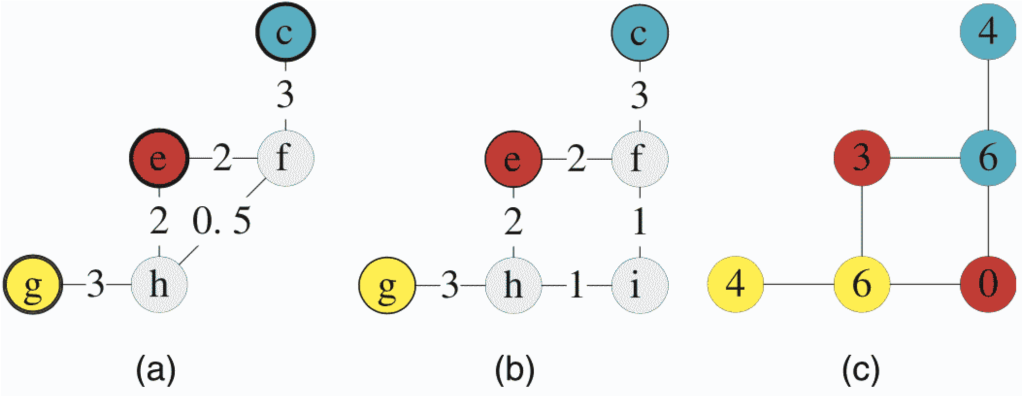

Fig.: An example of counterexample construction: initial seeds are shown in color in (a) and the determined image colors and final pixel labels are shown in (c). (a) Graph and seeds. (b) Counterexample. (c) Image color.

Algorithms: examples

How does it contribute to the overall solution?

This algorithm sharpens the input image, which improves the reliability of the text detection process.

What are the inputs and assumptions?

This algorithm has three inputs. These are two images, which should have the same dimensions, no greater than 1024×768 pixels, and a user-selected mixing ratio r in the range $[0, 1]$.

What happens in exceptional cases?

If two copies of the same image are provided as input, $\cdots$

Algorithms: examples

What are the outputs?

The output is a new image with the same dimension as the input image. A fraction r of its pixels are chosen at random from the first image, $\cdots$

For iterative algorithm, how to initialize?

The car tracking algorithm iteratively seeks the position of the car. In each video frame, this iteration is started by $\cdots$

Can user control the results, speed/accuracy trade-off?

The user must also supply a real tolerance t which controls the accuracy of the results $\cdots$

Algorithms: state in correct logical order

Do not write like this!

Read in the input data and process it to give the output, removing any noise from the input if necessary.

Explain the procedure in the correct logical order.

Read in the input data, remove any noise from it if necessary, and process it to give the output.

Algorithms: long descriptions is hard to follow!

Especially if there is

- Nested looping
- Or complex branching.

Use pseudo-code listing!

Algorithms: main program then each proced.

Describe the main program, briefly describing the purpose of any procedures it calls. Subsequently describe each procedure in more detail, as necessary.

Algorithm Text Summarization Algorithm

```
procedure TEXT DOCUMENT SUMMARIZATION
Input: A text document.
Output: Summary sentences.
    Creating information table from input document.
    Generate matrices.
    Call Procedure: Reduct construction [Alg. 2]
    Return: Summary sentences
end procedure
```

Algorithms: explain the pseudo-code

Describe how the pseudo-code works.

- Explain individual lines,
- or group of lines.

Text to explain, not repeat it in words!

Algorithms: tuning parameters

It is important to discuss all the tuning parameters.

- Suggest default/typical values and the range.
- Explain how you chose such values and range.
- Given a forward reference to experiments section if the values were determined experimentally.

Justify all tuning parameters!

Algorithms: how stable is the algorithm?

Experimentally verify how stable the algorithm is w.r.t. changes in the parameters.

- Much more convincing if you use **same** parameters for **all** your examples, rather than pick for each input.
- **Fewer** parameters means **easier** to use. Too much control freedom would be confusing.
- To what extend is the algorithm automatic?
- Make clear in **all** places where user input is required, and explain what form that user input takes.
- Explain how to choose **suitable** input.

Experimental Results

- For technical papers, this can be benchmark results.
- For theoretical papers, experiments could test aggreement between predicted values and those obtained by observation.
- Reports what you **did**, and what you **found out**, thus should be written in the past tense. The major part of the paper should be written in the **present** tense.

Experiments: each have a seperate purpose

Each should have a seperate, identified **purpose**.

Results for different kinds of input data.

Show the algorithm results w.r.t different kinds of input data, both typical, and extreme or unexpected.

Choosing parameters.

Show what happens with different settings of parameters, and how to optimally choose such parameters.

Not just be a set of results.

Experiments: each have a seperate purpose

Each should have a seperate, identified **purpose**.

- An experiments could validate some aspect of a theory.
- An experiment could provide a measure of the quality of the results of an approach.
- It is important to perform tests which enable comparisions with existing methods or theories wherever feasible.
- To get published, the idea needs to be better in some way.

Experiments: objective if possible

You should give **objective**, numerically quantified results whenever possible.

Our approach to image enhancement takes 7 s to process an image of size 1024×1024 pixels.

Figure 2 presents the precision recall curve of the saliency maps for thresholding in the range [0, 255].

Experiments: objective if possible

- First define **metrics** which will be used to evaluate your works against others.
- Collect the scores for each according to the chosen metrics.
- Be careful to make fair comparisons by running the test in an unbiased way.
- Papers only with qualitative, and rely on subjective judgement is rather hard to get accepted.

Experiments: steps

- Clearly stating its **purpose**, then how the experiment was **performed**.
- Give the results of the experiments.
- Provide an **interpretation** of the results, making explicit what you infer from them.
- Explain how and where you obtained any data used for testing, and why this particular dataset was used.
- Use standard benchmark with **GT** data if possible.
- Be **honest** in your descriptions of your experiments.
- All methods have **limitations**.
- Make sure that **any** conclusions you draw are supported by the results of your experiments, and that you do not over-generalise.

Experiments: state the purpose

Clearly stating its **purpose** and how the experiment was **performed**.

The aim of this experiment was to determine the radial lens distortion in the camera lens used in our system. An image was taken of the reference target described in Section 3.2. and the first and second order radial $\cdots$ using Algorithm 2 and Equation 6.

Experiments: results

Give the results of the experiments.

The first and second order radial and tangential distortion coefficients were determined to be $K_1 = 0.00037m^{-2}, \cdots, P_2 = 0.0000017m^{-4}$.

Experiments: interpretation

Provide an **interpretation** of the results, making explicit what you infer from them.

This might be how well your approach works in comparison to other methods, or how an algorithm scales with quantity of input data, or what the optimal conditions are.

Using Equation 9, the magnitude of these lens distortion coefficients indicate that, without correcting for lens distortion, the position of the robot can only be determined to within 8.5 cm, which is not adequate for safety. It is thus necessary to correct for lens distortion.

Experiments: explain the data

Explain how and where you obtained any data used for testing, and why this particular dataset was used.

To test our algorithm for removing motion blur, we collected as test cases the first 50 images returned by searching Google Image Search using keywords 'motion blur image'. These exhibited a range of subjects, and differing amounts of motion blur, allowing us to test how well our algorithm works with varying inputs.

Experiments: benchmark with ground truth

Use standard benchmark with **GT** data if possible.

For example, the ImageNet dataset have been widely used in image classification, and come with ground truth. The MS COCO dataset have been used in many papers on object detection, and come with ground truth.

Crucial for fair comparisons!

Experiments: honest descriptions

Be **honest** in your descriptions of your experiments. Clearly explain:

- What was successful and worked well.
- What did not work as expected, explain why not.
- Giving examples which show your method/theory works well, on the margin, and breaking down, allowing readers to better understand and characterise your achievements.

Avoid biasly selected examples.

Experiments: honest descriptions

Be **honest** in your descriptions of your experiments.

Our algorithm to generate music in the style of various classical composers worked well for Bach, Scarlatti and Mozart, where in each case the test subjects were able to identify the composer with with over 90% success rate (see Table 1). However, we were less successful at generating music in style of Stravinsky. Users only correctly identified this style in 42% of cases, despite having been given three different pieces by Stravinsky to listen beforehand.

Experiments: all methods have limitations

State clearly what the limitations of your method are, and also give suggestions as to how you might overcome them.

Our new battery technology is designed to operate at room temperature. It is unsuitable for outdoors use in cold conditions. Our test show that it can only provide 17% of its maximum working current at a temperature of 5 ℃. It might be useful to add an additional temperature control system to use this battery technology in outdoors.

Experiments: state purpose

Make sure that **any** conclusions you draw are supported by the results of your experiments, and that you do not over-generalise.

Our text recognition algorithm works well for English. However, it is unlikely to work well for Chinese, which has many more characters.

Conclusions

At the end of your paper, you should briefly restate your contributions and claims to **novelty**.

Our paper provides novel methods for segmenting a car from an image background, and for model-based tracking of cars in video. We show how to use these to estimate the speed of cars in video, for applications such as low enforcement and sports broadcasting.

Conclusions

Explain why your results are significant and useful, and summarise the experimental evidence, or theoretical proofs, which demonstrate how your ideas are an improvement over earlier work.

The only user interaction required is to indicate when the speed measurement should be taken. Using a tripod-mounted consumer-grade camera, an accuracy of 3 miles per hour can be achieved, within 10 seconds of computation. We have experimentally verified this accuracy by deploying our system by roadsides and obtaining ground truth speed by radar. Previous methods have needed user-assistance to find the car in the video, or were less accurate.

Conclusions

Also clearly state the limitations of your work.

Our system is generally reliable, but can occasionally fail for grey cars whose colour is too similar to that of road. Improved edge detectors may help to overcome this problem.

Acknowledgements

Briefly thank the founders, and *e.g.* industrial or other partners who have provided you with equipment, feedback, or other support. You should also thank other researchers who have provided you with their datasets, code, specimens and so on.

This research was supported by Major Project for New Generation of AI under Grant No. 2018AAA0100400 and National Science Foundation China under Grant No. 61922046. We also wish to thank Prof. Ralph Martin for providing the example images.

Acknowledgements

- Provide citations, links to code/data if possible.
- If you wish to reproduce the copyrighted works of others in your paper, it is general **not** enough to do so and simply mention them in the acknowledgements.
- You must get the copyright holder's written permission, although short extracts of written material **may** not need this.

> Figure 12. Text recognition results. Left: results produced by Chen's algorithm (From [16], used by permission of IEEE. ©IEEE 2009). Right: our results.

Acknowledgements

- You may have to pay licence fee to use material.
- Copyright laws can be complex, and vary from country to country.
- Even with permission, you should always state the source of copyrighted material where you use it.

The copyright needs to be made **perfectly clear**. Taking pieces of text from other papers (even your other paper) and using them in your own paper is unacceptable, and counts as plagiarism. Even short passages from other papers should be re-explained in your own words.

Acknowledgements

Fig.: Vectorizing Cartoon Animations, IEEE TVCG 2009.

References

- **Bibliography** is general list of papers, books, *etc.*
- **References** are items that you have specifically discussed and cross-referred to in your paper.
- Academic papers should contain only references, not a general bibliography.

References

References are used to demonstrate several key points and help readers to find out more about the subject.

- Show that you are familiar with the field, and its state-of-the-art. Only then are your claims of novelty likely to be plausible.
- Show how your work is an important over previous work.

Several previous works have considered three-dimensional omnispectral cameras [1,2,3], while others have considered four-dimensional hyper-spectral cameras [4,5,6,7]. Our work is the first to combine key elements from both of these devices, and to show how to construct a four-dimensional omnispectral cameras.

References

References are used to demonstrate several key points and help readers to find out more about the subject.

- Tell readers where to find details of any tools and other researchers' work you have used.
- Give background to your problem.

Our image extrapolation algorithms use combinatorial optimisation for finding matches between $\cdots$. We use the Hungarian algorithm [13] for efficiency.

Du *et. al.*gives a helpful survey of $\cdots$ in [13].

References format

Adopt the style of citations required by the conference or journal in which you hope to publish your paper. Some require references to be

- numbered in alphabetical order.
- in order of first appearance in the paper.
- referred by number, *e.g.* [1].
- referred by author and date, *e.g.* [Jones1999].

```
Chen \etal~\shortcite{Chen09Method} proposed
```

CONSISTENT and COMPLETE!

Appendices

The main purpose of using appendices is to provide supplementary materials, which is so lengthy that it would break the reader's flow of understanding.

An appendix might contain a long proof, where the important issue is the theorem itself.

An appendix might give a full description of some test data, where an outline will suffice for most readers, but full details are necessary and important for a reader wishing to replicate the results.

Q & A?