XIV
ON RESEARCH, WRITING AND SPEAKING

The following chapters contain general advice for students and researchers. This advice is not limited to computer vision, nor is it limited to researchers. It is our personal perspective on skills that a good computer vision practitioner should have. However, as in all advice, you should always get multiple opinions and choose the one that helps you become the most successful student, researcher, or engineer. See, e.g., the excellent videos from this 2018 workshop [375] from the Computer Vision and Pattern Recognition Conference (CVPR).

While there are many topics important to a researcher's career that we don't cover (how to review papers, mentor and advise, and manage collaborations), we hope that these chapters will be useful to both students, researchers, and engineers.

- **Chapter 52** presents actionable tips for doing research, especially for those just starting out.
- **Chapter 53** gives our tips for writing and organizing your research manuscripts.
- **Chapter 54** provides some tips for giving engaging talks and managing nervousness. Feel free to read these chapters at any moment and in any order.

52How to Do Research

52.1Introduction

The jump from problem sets into research can be hard. Sometimes we see students who ace their classes but struggle with their research. In little bites, here is what we think is important for succeeding in research as a graduate student. This chapter is written as advice from research advisor to a graduate student (so we use use the first person in the text), but we hope that this advice will be useful for anyone learning how to create and debug research or engineering projects.

52.2Research Advice

The first piece of advice can go on a bumper sticker: **“Slow down to speed up.”** In classes, the world is rigged. There's a simple correct answer and the problem is structured to let you come to that answer. You get feedback with the correct answer within a day after you submit anything.

Research is different. No one tells you the right answer, and we may not know if there is a right answer. We don't know if something doesn't work because there's a silly mistake in the program or because a broad set of assumptions is flawed.

How do you deal with that? Take things slowly. Verify your assumptions. Understand the thing, whatever it is—the program, the algorithm, or the proof. As you do experiments, only change one thing at a time, so you know what the outcome of the experiment means.

It may feel like you're going slowly, but you'll be making much more progress than if you flail around, trying different things, but not understanding what's going on.

Figure 52.1: Research advice for a bumper sticker.

Please don't tell me "it doesn't work." Of course, it doesn't work. If there's a single mistake in the chain, the whole thing won't work, and how could you possibly go through all those steps without making a mistake somewhere? What I want to hear instead is something like, "I've narrowed down the problem to step B. Until step A, you can see that it works, because you put in X and you get Y out, as we expect. You can see how it fails here at B. I've ruled out W and Z as the cause."

"This sounds like hard work." Yes. It's no longer about being smart. By now, everyone around you is smart. In graduate school, it's the *hard workers* who pull ahead. This happens in sports, too. You always read stories about how hard the great players work, being the first ones out to practice, the last ones to leave, and so on.

> A co-author, who generally works harder than I do, tells me I should add comments here about the importance of taking time off from work and maintaining a good life/work balance. That is true: you should work at a pace you can sustain, and you should refresh yourself by making time for the things that matter more than work, such as relationships, service, and relaxation. Perhaps the point is to protect your time so you will have enough time to do the research well.

"How do I get myself to work hard enough to do research well?" It all plays out if you love what you're doing. You become good at it because you spend time at it and you do that because you enjoy it. So pick something to work on that you can love. If you're not the type who falls in love with a problem, then just know that working hard is what you have to do to succeed at research.

The above isn't completely true. Beyond working hard, there's also *steering*. We're like boats. We need motors—that's the part about working hard. But we also need a rudder for steering—that means stepping back periodically to make sure we're working on the right thing. On the topic of steering, I find time management books to be very helpful. They teach you how to spend your time solving the right problems.

Toy models. There's a concept I want a simple phrase for, and maybe you can help me think up a good name. It's "the simplest toy model that captures the main idea" (TSTMTCTMI). Anyway, simple toy models always help me. With a good one, you can build up intuition about what matters, which is a big advantage in research.

Here's an example. The color constancy problem is to estimate surface reflectance colors when we only get to observe the wavelength-by-wavelength product of the each surface reflectance spectrum and the unknown illuminant spectrum. A toy model for that problem is to try to estimate the scalars a and b from only observing their product, $y = a \times b$. There's a surprising richness even to this simple problem, and thinking about it allows you to think through loss functions and other aspects of Bayesian decision theory (figure 52.2). I co-authored a paper that discusses $y = a \times b$ for much of the manuscript [143]. Another toy model is to consider, as a proxy for complicated shaded surfaces, a single bump. You get the idea.

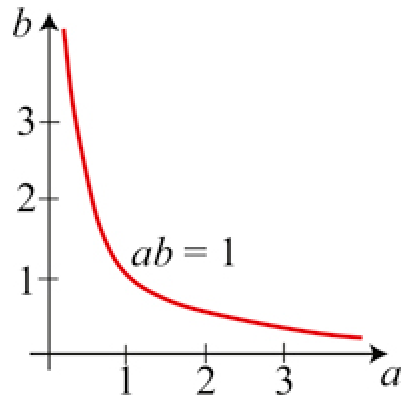


Figure 52.2:A toy model for the color constancy problem: $y = a \times b$. The plot shows the possible solutions for a and b when $y = 1$.

Having the intuitions from working with toy problems gives you a big advantage in the research, because you can figure out what will work by thinking it through with your toy model.

Strategies for success. Here is a parable, as told by my friend Yair Weiss. There is a weak and a strong graduate student. They are both asked by their advisor to try a particular approach to solving a research problem. The weak student does exactly what the advisor has asked. But the advisor's solution fails, and the student reports that failure. The strong student starts doing what the advisor has asked, sees that it doesn't work, looks around within some epsilon ball of the original proposal to find what does work, and reports that solution.

Figure 52.3: The parable of the two students.

Sometimes it's useful to think that everyone else is completely off-track. This lets you do things that no one else is doing. It's best not to be too vocal about that. You can say something like, “Oh, I just thought I'd try out this direction.”

It's also sometimes useful to remember that many smart people have worked on this and related problems and written their thoughts and results down in papers. Don't be caught flat-footed with a large body of closely related literature that you aren't familiar with.

How a business school might talk about your research. You have a brand: you. There are many impressions you want to build up about your brand: that person always does great work, they have good ideas, they give great talks, they write wonderful software. Promote your brand. Build up a great reputation for yourself by consistently behaving in the way you'd like to be thought of.

Cultivate your strengths and play to those strengths. Some possible strengths include being broad, being creative, being a great implementer, or being great at doing theory.

Please don't report to me and say, "This instance doesn't work." Why doesn't it work? Why should it work? Is there a simpler case we can make work? Do you think it's a general issue that affects all problems of this category? Can you think of what's not working? Can you contort things to make an example that does work? At the very least, can you make it fail worse, so we understand some aspects of the system?

Progress. I love to hear about progress when I meet with students, but note that I have a very general notion of progress. Progress can include things like "I've shown why this doesn't work," "I've simplified the task to get it to start working," or "I spent the whole time reading because I know I have to understand this before I can make any progress."

Please don't hide from me. Let's talk. I like it when you track me down and insist that we talk, for example, if I've been traveling.

On collaboration. Science is generally a team sport. What matters in a collaboration is whether the work is insightful, foundational, or impactful. It doesn't matter that many people were involved. It is much better to be one of 10 contributors to a great paper than to be the sole author on an unimportant paper. The relationships formed through collaborations can become friendships that last over your career.

On authorship. What names should be on a paper? Everyone who contributed to the paper. Contributions can be through experimentation, contributing a seminal idea that the paper builds on, or helping with the writing. Sometimes an authorship contribution can include trying out a research direction that didn't work. If I'm on the fence about whether someone contributed enough to be an author, I usually ask the person themselves, and go with whichever outcome they prefer.

52.3Concluding Remarks

For a presentation to the visiting admitted MIT computer science graduate students, I emailed all MIT Computer Science and Artificial Intelligence Laboratory (CSAIL) researchers and faculty members, asking "Please send me what you think is the most important quality for success in graduate school." I compiled their responses (along with photos of the responders) into slides that are available online:
http://people.csail.mit.edu/billf/talks/10minFreeman2013.pdf

I think it's a lot of good advice about research.

> **One final note about doing research.** We hope you love it. We certainly do. The research community is a community of people who are passionate about what they do, and we welcome you to it!

53How to Write Papers

53.1Introduction

An important part of research is communicating your results to others, so we include our thoughts about how to write good papers. A video presentation of material related to this chapter is [146].

Many graduate students we know feel it is important to coauthor many papers. While the number of papers a student has can be a rough measure of research productivity, it is our experience as mentors, faculty search committee members, and industrial research managers that *only the good papers count*. (We acknowledge that this is not true everywhere, and some institutions simply count papers. But you should still strive to make all your papers good!) This emphasis is shown in figure 53.1 , a plot of made-up data that summarizes our impression, formed over many years, of the relationship between paper quality and its impact on one's career. Only the really good papers matter for your career. So it makes sense to learn how to write the best possible paper from any given piece of research work.

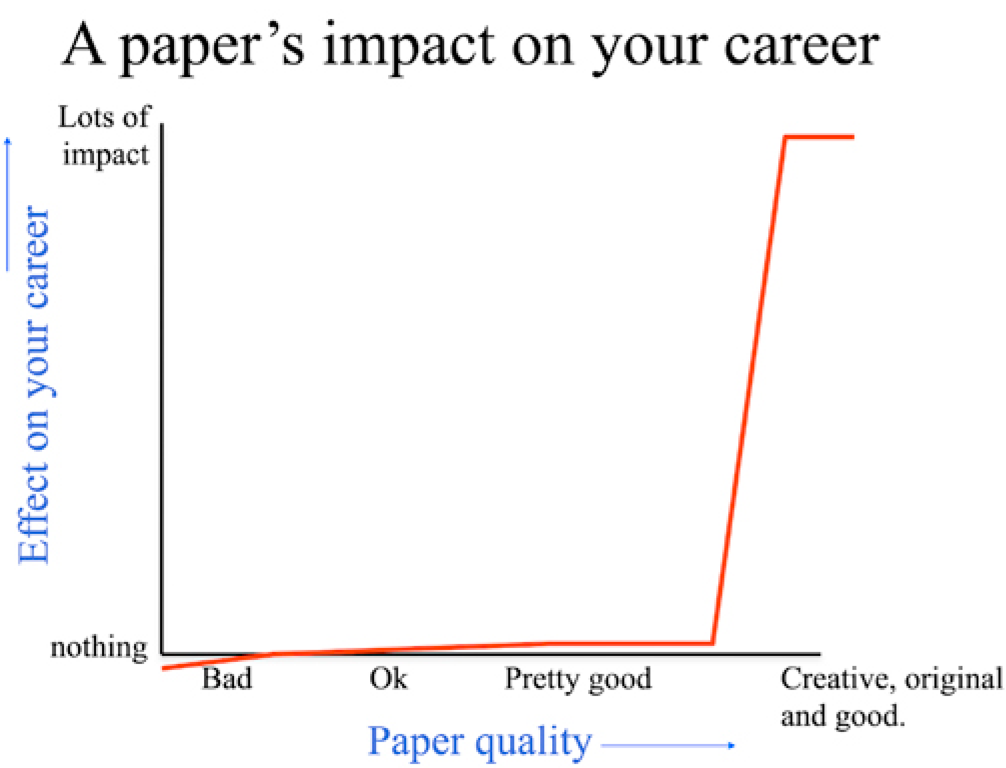


Figure 53.1: Plot of conjectured data showing the impact of a paper on one's career, as a function of paper quality.

53.2Organization

The Ph.D. thesis advisor of two of us, Prof. Edward Adelson, wrote some good advice in response to a student's question of how to write a good paper [5]:

- Start by stating which problem you are addressing, keeping the audience in mind. They must care about it, which means that sometimes you must tell them why they should care about the problem.
- Then state briefly what the other solutions are to the problem, and why they aren't satisfactory. If they were satisfactory, you wouldn't need to do the work.
- Then explain your own solution, compare it with other solutions, and say why it's better.
- At the end, talk about related work where similar techniques and experiments have been used, but applied to a different problem.

That structure fits well with a progression of section headings typical of many conference papers. As an example, here are the headings from paper [125], coauthored by one of us. The structure is useful for many research papers:

1.Introduction
2.Related work
3.Main idea
4.Algorithm
    4.1Estimating the blur kernel
        4.1.1Multiscale approach
        4.1.2User supervision
    4.2Image reconstruction
5.Experiments
    5.1Small blurs
    5.2Large blurs
    5.3Images with significant saturation
6.Discussion

53.2.1The Paper's Introduction

Regarding paper introductions, Kajiya [246] writes, “You must make your paper easy to read. You've got to make it easy for anyone to tell what your paper is about, what problem it solves, why the problem is interesting, what is really new in your paper (and what isn't), why it's so neat. And you must do it up front. In other words, you must write a dynamite introduction.”

53.2.2Main Idea

When appropriate to the paper, it can be very helpful to show a simple example that captures the main idea of the paper. Here is a figure from a different paper [442] that conveys the main idea very simply. The paper's main idea was that wavelets lacked important desirable features for an image representation. Figure 53.2 shows the failure of a wavelet representation to form a translation invariant representation. The top row shows two versions of the same signal, differing only in a one-sample translation. The bottom three rows show the coefficients of the high-, mid-, and low-frequency bands of a wavelet representation of that signal. The figure points out in a simple way the drawback of a wavelet representation with aliased subbands that was the focus of the paper: as the signal translates, the signal representation energy moves to different frequency bands and changes form within the mid-frequency band.

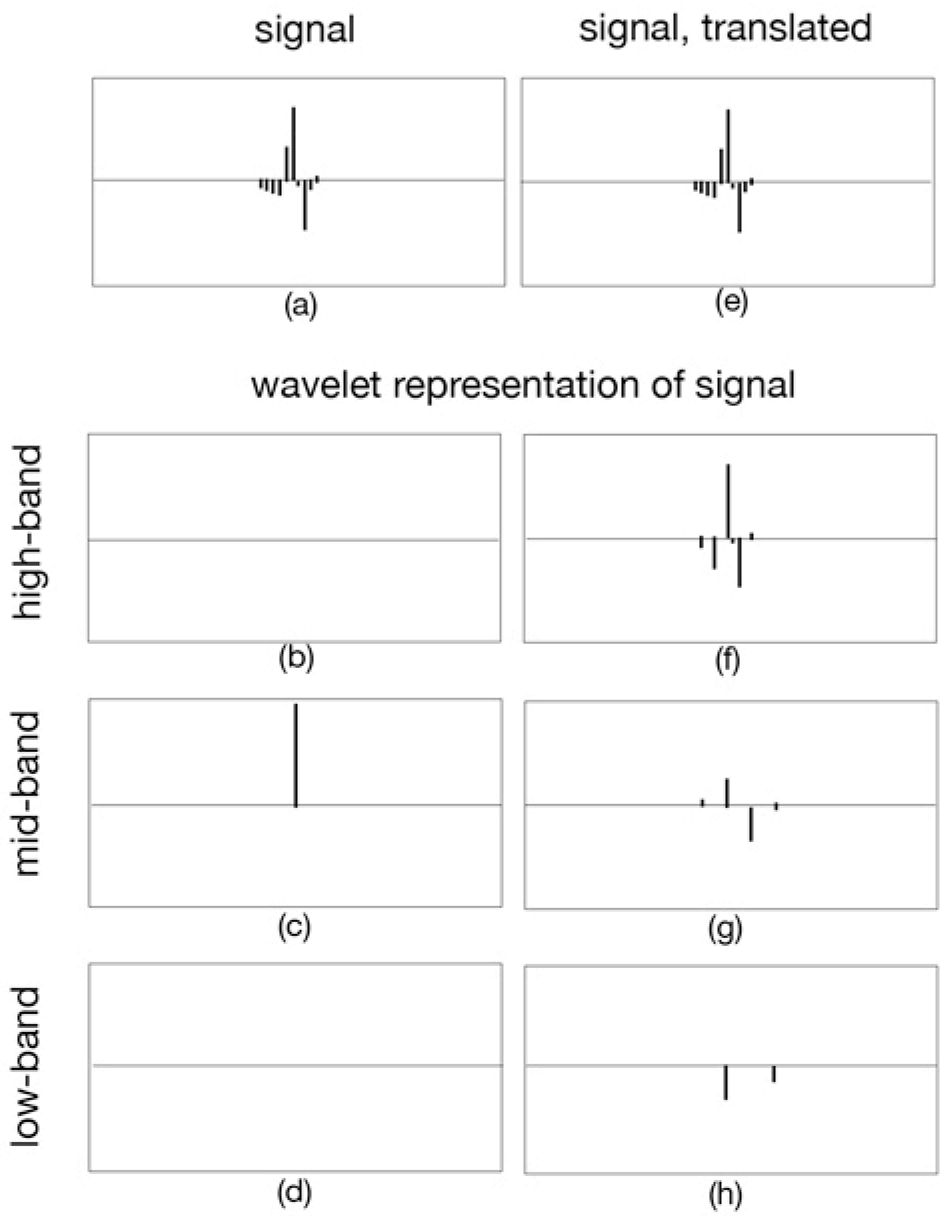


Figure 53.2: Effect of translation on the wavelet representation of a signal (caption and figure after [442]). (a) An input signal. (b-d) The high-, mid-, and low-frequency coefficients within a wavelet subband decomposition. (e) The same input signal, translated one sample to the right. (f–h) The decomposition of the shifted signal into the same three bands. Note the drastic change in the transform coefficients induced by the shift.

53.2.3Experimental Results

In earlier days of computer vision research, good ideas could be presented with only plausibility arguments to support them. However, modern standards require that assertions in a paper be backed up with experimental evidence. Readers will be expecting a table quantitatively comparing the performance of your algorithm with that of the previous state-of-the-art. If you are proposing a new task for which there aren't previous benchmarks, you should still compare with an algorithm that solves a related task, noting that the algorithm was designed for a different task.

Psychophysical study		Loudness		Centroid	
Algorithm	Labeled *real*	Err.	r	Err.	r
Full system	**40.01% ± 1.66**	**0.21**	**0.44**	**3.85**	**0.47**
- Trained from scratch	36.46% ± 1.68	0.24	0.36	4.73	0.33
- No spacetime	**37.88% ± 1.67**	0.22	0.37	4.30	0.37
- Parametric synthesis	34.66% ± 1.62	**0.21**	**0.44**	**3.85**	**0.47**
- No RNN	29.96% ± 1.55	1.24	0.04	7.92	0.28
Image match	32.98% ± 1.59	0.37	0.16	8.39	0.18
Spacetime match	31.92% ± 1.56	0.41	0.14	7.19	0.21
Image + spacetime	33.77% ± 1.58	0.37	0.18	7.74	0.20
Random impact sound	19.77% ± 1.34	0.44	0.00	9.32	0.02

(a) Model evaluation

Figure 53.3:A prototypical table of results, from [369] Rows are different algorithms, or ablations of a favored algorithm. Columns are datasets or tasks, and the numbers indicate performance, with the best performances given in bold.

53.2.4How to End the Paper

A cautionary note on how *not* to end the paper. Conference papers are often written under deadline pressure, and there is inevitably a list of results that the authors wanted to obtain that have been left uncompleted. You should resist the temptation to describe the items that were left unfinished in a section on “Future Work.” It is hard to imagine a weaker way to end the paper than to enumerate all the things the paper doesn't accomplish, providing a summary of where it falls short.

Instead, the paper can finish with a review what has been presented, emphasizing the contributions. How has the world changed, now that the reader has read this paper? What new research directions have been opened up; what can we do now that we couldn't do before?

53.3General Writing Tips

Donald Knuth, the author of the classic book series, *The Art of Computer Programming*, wrote [267], "Perhaps the most important principle of good writing is to keep the reader uppermost in mind: What does the reader know so far? What does the reader expect next and why?"

Our mental image is that of a great host, who anticipates every need of their house guest: after you arrive, they say, "Can I take your coat? Would you like something to drink?" At every moment, they know what you might be wanting and how to help you find it.

53.3.1Use Fewer Words

In *The Elements of Style* [455], Strunk and White write, "Vigorous writing is concise. A sentence should contain no unnecessary words, a paragraph no unnecessary sentences, for the same reason that a drawing should have no unnecessary lines and a machine no unnecessary parts."

To make this point in the context of scientific writing, the following is a paragraph that one of the authors of this textbook wrote with a student.

> The underlying assumption of this work is that the estimate of a given node will only depend on nodes within a patch: this is a locality assumption imposed at the patch-level. This assumption can be justified in case of skin images since a pixel in one corner of the image is likely to have small effect on a different pixel far away from itself. Therefore, we can crop the image into smaller windows, as shown in Figure 5, and compute the inverse J matrix of the cropped window. Since the cropped window is much smaller than the input image, the inversion of J matrix is computationally cheaper. Since we are inferring on blocks of image patches (i.e., ignoring pixels outside of the cropped window), the interpolated image will have blocky artifacts. Therefore, only part of xMAP is used to interpolate the image, as shown in Figure 5.

Original text: 149 words.

While the text above conveys the desired technical information, it describes things in a roundabout way. The word count is 149. Below, the paragraph has been rewritten to just 88 words without changing its meaning.

> We assume local influence—that nodes only depend on other nodes within a patch. This condition often holds for skin images, which have few long edges or structures. We crop the image into small windows, as shown in Fig. 5, and compute the inverse J matrix of each small window. This is much faster than computing the inverse J matrix for the input image. To avoid artifacts from the block processing, only the center region of xMAP is used in the final image, as shown in Fig. 5.

Rewritten text conveying the same information: 88 words

Note that writing more concise text helps your paper in two ways. First, researchers are typically fighting against a page limit, particularly in conference submissions, so tighter text lets the author say more or add another figure. Second, concise text is usually clearer and easier to understand.

53.3.2Title, Figure Captions, and Equations

While we may imagine our reader reading every word of our paper, in our current era of many published papers, most of your readers will probably only skim your paper. We suspect that the engagement of readers with your paper will look something as shown in figure 53.4.

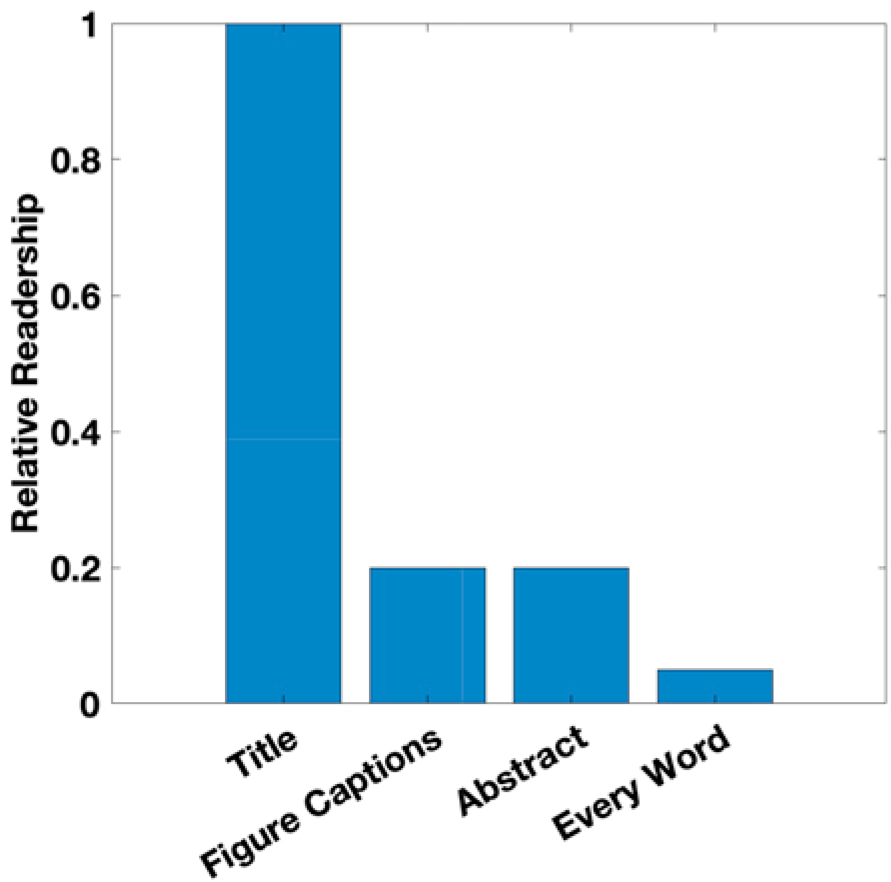


Figure 53.4: The conjectured readership of a computer science paper (conjectured relative amounts). Many people will read the title, but far fewer will read the abstract or look at the figures. Fewer still will read every word of the paper. You should allow readers to access your paper at each level of engagement.

If only because that is where most of your readership lies, you should write your paper so that readers will learn from it, even at those reduced levels of engagement. The title should convey the top-level message of the paper. The figures and their captions should be self-contained and tell the story of the paper. The abstract should provide a good summary.

A good title can generate attention and interest for the paper. “What makes Paris look like Paris” [104] is a delightful paper, and the title lets the reader see that right away. In contrast, one of us coauthored a paper called “Shiftable Multi-scale Transforms.” While that title is appropriate, it's not catchy. After the paper was in print, we realized that we should have added the subtitle, “What's wrong with wavelets?” — a catchy phrase that tells the main point of the paper.

Because you can assume that many of the readers of your figure captions will not be reading the full paper, *the captions should be self-contained*. They should point out what readers are supposed to notice about the figure, to help both the full-paper reader and the figures-only reader. Figure 53.5 shows an example.

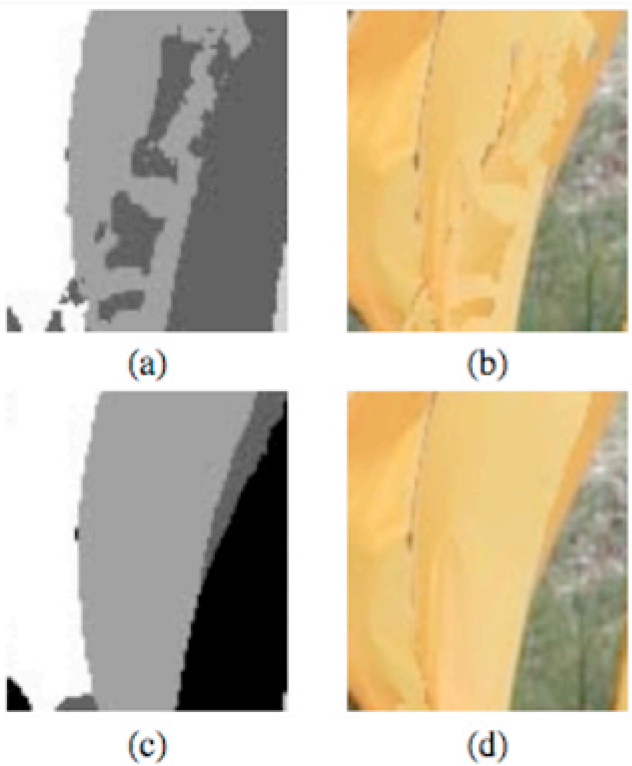


Figure 3: (a) Time-frame assignments for the front-most surface pixels, based on stereo depth measurements alone, without MRF processing. Grey level indicates the time-frame assignment at each pixel. (b) Shape-time image based on those assignments. (c) Most probable time-frame assignments, computed by MRF. (d) Resulting shape-time image. Note that the belief propagation in the MRF has removed spurious frame assignment changes.

Figure 53.5: Figure and caption from [144]. The caption should be understandable by itself, and should point to what the reader should take away from the figure.

Equations interposed with text can pose a challenge to the reader. Does the reader stop to work through each equation, or continue reading as quickly as if the equation were words? Knuth [267] and

Mermin [331] both give advice on writing with equations. Knuth writes, "*Many readers will skim over formulas on their first reading of your exposition. Therefore, your sentences should flow smoothly when all but the simplest formulas are replaced by 'blah' or some other grunting noise.*"

Mermin adds, "*When referring to an equation identify it by a phrase as well as a number. No compassionate and helpful person would herald the arrival of Eq. (7.38) by saying 'inserting (2.47 and (3.51 into (5.13)…' when it is possible to say 'inserting the form (2.47 of the electric field E and the Lindhard form (3.51) of the dielectric function into the constitutive equation (5.13)…'* "

53.3.3Tone

The tone of your writing is important. You may feel pressure to oversell, hide drawbacks, and disparage others' work. It is in both your short-term and your long-term interest not to succumb to that pressure! If your work has a shortcoming, it is much better that you point it out than to have someone else do so later.

Papers written from the point of view that "we're all good researchers, doing our best" are much more pleasant to read than papers written from the standpoint that everyone else is an idiot. Note the delightful sentences written by Efros [114] when he was a graduate student, "*A number of papers to be published this year, all developed independently, are closely related to our work. The idea of texture transfer based on variations of [6] has been proposed by several authors (in particular, see the elegant paper by Hertzmann et al. in these proceedings). Liang et al. propose a real-time patch-based texture synthesis method very similar to ours. The reader is urged to review these works for a more complete picture of the field.*" This generous tone wins over the reader and promotes long-lasting friendships with people who study the same problems you do.

You should develop a reputation for being clear and reliable. Always convey an accurate impression of the performance of an algorithm. If something doesn't work in important cases, let the readers know. In [125], we noted that our deblurring algorithm didn't work for a case where we had been sure it should work for a maximum a posteriori (MAP) estimation of the deblurred image. Some years later we learned, and described in [291], that we had been wrong to believe that MAP estimation of the deblurred image was feasible. We were glad we had described our counterintuitive result years before.

53.3.4Author List

The quality of the papers you write matters so much more than your positions within the author lists of the papers. If adding more authors will make a paper better, then you should add more authors. If a collaborator feels they should be an author, but you yourself are not sure, we find it is generally a good idea to trust the collaborator and to add them as a coauthor. It's much better to be one of many authors on a great paper than to be one of just a few authors on a mediocre paper.

53.3.5Avoiding Rejection

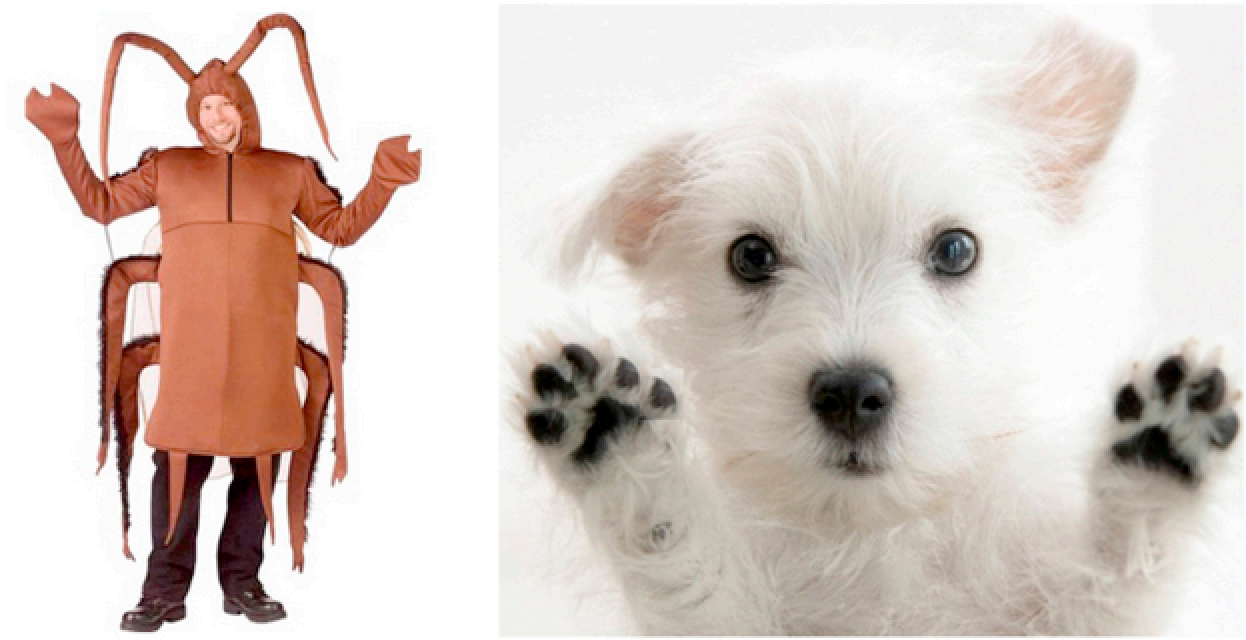
With the task of rejecting at least three-quarters of the submissions, conference area chairs, who make the acceptance decisions, are grasping for reasons to reject a paper. Here's a summary of reasons that are commonly used, and it is best not to provide the area chair with any of these easy reasons to reject your paper:

- Do the authors not deliver what they promise?
- Are important references missing (and therefore one suspects the authors not up on the state of the art for this problem)?
- Are the results too incremental (too similar to previous work)?
- Are the results believable, with sufficient tests to support the claims?
- Is the paper poorly written?
- Are there mistakes or incorrect statements?

As an area chair, the very good and the very bad papers are easy to deal with, and most of the decision-making effort goes to the borderline papers. One of us writes, “I find that much of my time is spent dealing with two kinds of borderline papers: cockroaches and puppies with six toes.”

“Cockroaches” have no exciting contributions, but the reviews are ok and the results show incremental improvement to the state of the art. They're hard to kill (hence the nickname), and maybe two-thirds are accepted as posters, and one-third are rejected. As an author, it's best to work harder for the fresh results, to bring papers like this out of the cockroach category.

At the other end of the spectrum of borderline papers are “puppies with six toes.” These are delightful papers, but with an easy-to-see flaw. The flaw may not matter (like six toes on a puppy) but makes the paper easy to reject, even though the paper may be fresh and wonderful. Maybe two-thirds of those papers get rejected, and one-third maybe accepted as posters. As an author, it may be better to wait for another submission cycle with a paper like this, to remove the easy to spot flaw. Then the paper might receive an oral presentation at a subsequent conference submission cycle.



(a) Cockroach

(b) Puppy with six toes

Figure 53.6: Borderline papers from an area chair's perspective. (a) The cockroach represents a mundane, hard-to-reject paper with no glaring issues [121]. (b) The six-toed puppy represents delightful paper with some minor, easily spotted flaw, leading to potential rejection [221].

53.4Concluding Remarks

The approaches to writing and editing described previously all take time: good writing involves lots of rewriting. We find that the last days before a paper submission deadline are often better spent improving the structure, presentation, and clarity of the paper than in trying to obtain last-minute improvements to the results.

54How to Give Talks

54.1Introduction

Giving good talks is important for people who use the material of this book–for students, researchers, and engineers. One might think, “It is the work itself that really counts. Giving a talk about it is secondary.” But the ability to give a good talk is like having a big serve in tennis—by itself, it doesn't win the game for you, but it sure helps. And the very best tennis players all have great serves. So we include in this chapter material that we have found helpful in giving talks.

There are many other sources for giving talks, and you should access several of them to pick out the tips that work best for you. Prof. Patrick Winston's talk about giving talks is great [505], and another good source is this book [214]. This chapter has heuristics that have worked well for us.

54.1.1A Taxonomy of Talks

There are different kinds of talks. Conference and workshop talks may range in length between 3 minutes for a “fast-forward” talk to 45 or 60 minutes for a keynote address. You may be one of many speakers, sometimes speaking in different rooms at the same time. Sometimes you will visit a university or company and speak in a special seminar. (Here [15] is a list of tips regarding faculty job talks from the MIT faculty.)

It is very often the case that the audience will have a wide range of familiarity with the work and topic that you will present about. In a small seminar to a competing research group, there may be many people who are very familiar with your work. But even in such a small seminar, and especially to a larger group, there may be many people who don't know your area, nor perhaps not even your broad area. So you will to include material to let the uninitiated not be lost. Even people who are very familiar with the topic will appreciate hearing material they already understand presented clearly and well.

The tips in the chapter apply to talks of all lengths. However, one class of talks is so short as to be a special case: the very short talk.

54.2Very Short Talks (2 – 10 Minutes)

Short talks are often advertisements, designed to persuade the listener to read your paper, or to listen to a longer version of the talk. Rather than trying to convey many details about your work, you should aim to have the audience remember the main idea behind your work, and to share your excitement about the work.

For five minute talks describing students’ final project class presentations, we suggest that the students cover these points:

1.What problem did you address?
2.Why is it interesting?
3.Why is it hard?
4.What was the key to your approach?
5.How well did it work?

That structure can be used for other short talks, too. For very short talks, the time needed to go through the whole thing is minimal, and there is no excuse not to practise the talk, from start to finish, several times. Next, we cover points that we feel relate to all types of technical talks, regardless of length.

54.3Preparation

Figure 54.1: The key to a good talk: preparation and practice.

We believe the keys to both a good talk and to overcoming nerves are the same: prepare and practice. Think through your talk. It's almost always better to give a talk from notes than to read it from a script–the audience feels you're speaking to them so it's easier for them to pay attention. But for people giving a talk in a language that they are not comfortable with, writing out a script ahead of time may be a better solution. There may be parts of the talk that you feel are difficult to get through. For those parts, even for a native speaker, it may help to write out what you plan to say. When you give the talk, you may ignore the script, but having written it out once will make it easier to say.

Think through the talk and find the story–how one part relates to the next. If you can't find that story, you may want to reorder the presentation to create a good story.

When you can, you should visit the room you'll be speaking in to identify any issues that may come up. Will you be blocking anyone as you stand at the lectern to give the talk? Will there be someone there to help you set up? You should decide how to position yourself so that you can see your presentation, and also engage well with the audience.

54.4Nervousness

One of us writes, “I used to be a nervous public speaker. I still find the hours before giving a presentation to be stressful. I'm always reviewing my talk to try to improve it or to track down the answers to questions I think someone might ask me. The more I prepare, and the better I know the lecture material, the less stressed I am.”

A great cure for nervousness is to practice the talk aloud. Practice by yourself. Practice in front of your friends.

One approach [214] to calming nervousness is to remind yourself, “Get over it. They're not there to see you, they're there to hear the information. Just convey the information to them.”

Some find this quote, attributed to Dr. Rob Gilbert [162], to be helpful: “It's all right to have butterflies in your stomach. Your job is to get them to fly in formation.”

54.5Your Distracted Audience

Before giving a talk, your mental image of the audience may be of many people, listening to your every word. In reality, on most every speaking situation, your audience is a collection of people who are checking their social media or email, looking on their laptops for other talks to attend, or are hungry or fidgety. How does one speak to such an audience? We have to practise and prepare in order to engage the audience.

54.6Ways to Engage the Audience

In the middle of Patrick Winston's talk about public speaking [505], he asks the audience the question, “Can you think of a technique to get the audience more engaged in the talk?” The answer, of course, is to ask them questions.

Bill Hoogterp [214] expands on that: “The audience is like a sheep dog, always wanting to be working. Give the audience something to work on while they're listening to you. ‘Four’ pushes people back, while ‘two plus two’ draws them in.” You might pose a sub-problem to them that you had to address in your work, to get them thinking about how to solve that problem. Then they'll be more receptive to hear your solution.

54.6.1Layer Your Talk

It's often easier for the audience to listen to your talk if you layer it—provide verbal cues for new concepts and transitions between sections of the talk. This helps even the attentive listener to follow the structure of your talk. It keeps the distracted listener from being completely lost. The distracted listener, only listening for the verbal headings of your talk, may hear, “The probability of an observation has three terms to it. … blah blah blah blah … So that gives us the objective function we want to optimize. Now, how do we find the optimal value? There are two approaches you can take. … blah blah blah blah So now, with these tools in hand, we can apply this methods to real images. … blah blah blah blah …” Your verbal cues can help even a distracted listener follow your main points.

You can also make your talk easier to follow if you add verbal dynamics—variations in speed or intensity. Find a part of the talk that is particularly special to you and let that show through. One of us writes, “When I gave talks about image deblurring, I would emphasize one aspect that I particularly enjoy: ‘I love this problem; it's beautifully underdetermined. There are many ways we can explain a blurry image. It could be that that's what was there in the world— we took a sharp picture of a world that happened to look blurry. Or we took a blurred image of a sharp world.’ ” The audience loves to watch you be excited about something!

54.6.2People Like to See a Good Fight

As described by Adelson [6], the audience loves to watch a good fight. You can set up a fight between two competing conjectures. For example, you might say, “The flat earth theory predicts that ships will appear on the horizon as small versions of the complete ship. Under that theory, you'd expect approaching ships to appear as in figure 54.2(a). Conversely, the round earth theory predicts that the top of the sails will appear first, then gradually the rest of the ship below it, resulting in approaching ships looking as in figure 54.2(b). The audience waits with anticipation as you show them the result from your experiment, figure 54.2(c), thus revealing the winning theory.

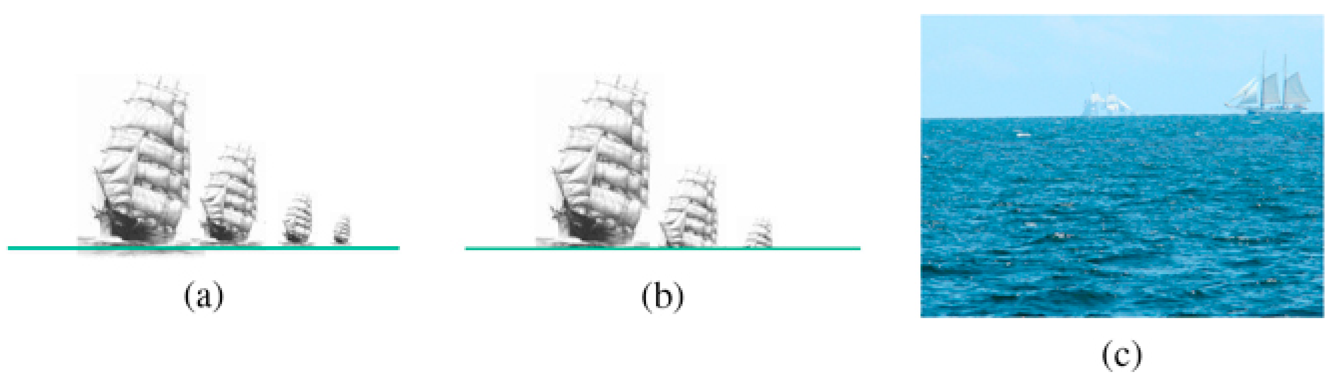


Figure 54.2:(a) The appearance of ships approaching a port, from the flat-earth theory. (b) Their appearance as predicted by the round-earth theory. (c) The experimental evidence: a photograph of ships approaching a port [387].

54.7Show Yourself to the Audience

In a lovely video, the actor Alan Alda describes the importance of connecting with the audience in scientific presentations [14]. Alda noted the improvement in scientific speaking of volunteers after they engaged in improvisational theater exercises. After the exercises, the volunteers were primed to engage and connect with others, and their scientific talks sparkled.

Here's what we think an audience wants from a technical talk: (a) To have one part follow from another and make sense. (b) To learn a few things. (c) To connect with the speaker, to share their excitement for the topic. They want to watch you love something!

54.7.1How to End the Talk

How should you end your talk? A common, but awkward, way is to end by asking, “Are there any questions?” The audience wants to clap at the end of a talk, but with that ending, they don't know whether to applaud or to ask a question, and they're likely to give only scattered applause [6]. Better is to close with “Thank you.” The audience then knows it's their time to applaud, and they will. Then you can ask for questions.

We note that Patrick Winston disagrees with ending a talk with “thank you” [505]. He didn't like the implication that the audience was doing you some favor for attending your talk, and preferred to remind the audience of how he has kept his earlier promise to them regarding what they would learn after they listened to his talk.

54.8Concluding Remarks

Prepare and practice your talks! As you give the talk, let the audience see how much you enjoy what you've worked on. Follow-up with the references in this chapter to find the collection of talk tips that works best for you. Preparation and rehearsal are the best cures we know of for nervousness about giving a talk.

XV
CLOSING REMARKS

The purpose of this book was to cover foundational concepts that, in many cases, have already passed the test of time, and others that we believe are likely to pass it in the future. These concepts should help the reader to understand future advancements beyond what has been covered here.

With all the material presented in this book, we have now the tools to revisit the simple visual system we explored in chapter 2 and try to solve it in a different way to what we proposed earlier, which will conclude this book.