

A Mathematical path to Engineering

A Constructive Decalogue of formulas and recipes

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These notes have been gathered to 20 years of career.

First release, yet do not know



Contents

1	Introduction	5
1.1	Motivation	5
1.2	Objective	5
1.2.1	References	6
2	Set Theory: preliminaries	7
2.1	First ideas	7
2.1.1	Superpixel segmentation	8
2.1.2	PCA	8
2.2	Hypothesis	9
2.2.1	Topics you should review	10
2.2.2	Downloading	11
3	Precalculus	15
3.1	What is an image?	15
3.1.1	FITS files	15
3.1.2	WFC3 ERS M83 Data Products	16
3.2	Preprocessing your data	16
3.3	Software available	19

4	Signal Processing	21
4.1	Complex Numbers	21
4.1.1	ESOM, Evolving Self Organizing Maps	21
4.1.2	CSOM	26
4.2	Further work	27
4.2.1	Some interesting ideas	27
4.2.2	Links you should check out	28
5	Number Theory	29
6	Pragmatic Control Theory	31



1. Introduction

1.1 Motivation

Sometimes we get lost on the true origin of Engineering. Which is the practical implementation of mathematics.

1.2 Objective

The purpose of this work is to establish in a step by step and constructive fashion a set of mathematical concepts from a pragmatic point of view, of mathematical ideas that are useful to engineering.

Everything that is written here is exactly what I understand. If anything is besides this notes, I just put it in the category of "Not-understanding".

What I found is that I came to this notes, many times, adding more information and connections to other things, and I will always understand the same things from a different and completely new perspective.

After a while I found that I will be very dissapointed of loosing those notes so I decided to write them down digitally. And have a backup with that.

How can you translate something that you created with your own pen ? from your own handwriting ? into something digital that is feel so cold to the naked eye.

Someone may found these notes useful. I believe that will be for two reasons: I wanted to create them in a constructive way: if I cannot find some rule to justify what I am doing then I am not doing anything, it doesn't exist. The second reason is that I always found mathematics to be hard. I love to understand it but it takes time to do it, to sit down. At the same time, "undestanding" is not binary. The best analogy I found is like a complex and evolutive graph or a tree-like structure, with many branches. Let's say you understand something. Then you have only "one path" to go from point A to point B of the concept. But you can only walk across that path, and you, somehow, can follow the train of thinking from one place to the other. However you cannot connect it to other things. When you teach, somebody may point out the existence of point C closer to both. But you were completely unaware of it until some student ask you something about it. Then you discover that connection (and manage to give a response to the poor student, which it will be satisfactory or just mumble jamble).

Then you start to discover many more ramifications and your level of understanding increases. So understanding, is the level of ramification that you know of something, how much can you connect the concept to others.

for Control engineering for instance, everything can be a control problem. The same can be applied to the "Rule of 3" or proportions or fractions. Or algebra. These very important tools allows you to tackle problems that is the reason they are so ubiquitous. In such way the Consciousness theory share some intuition with these concepts, measuring the level of integration and connectivity (Rhythms of the brain).

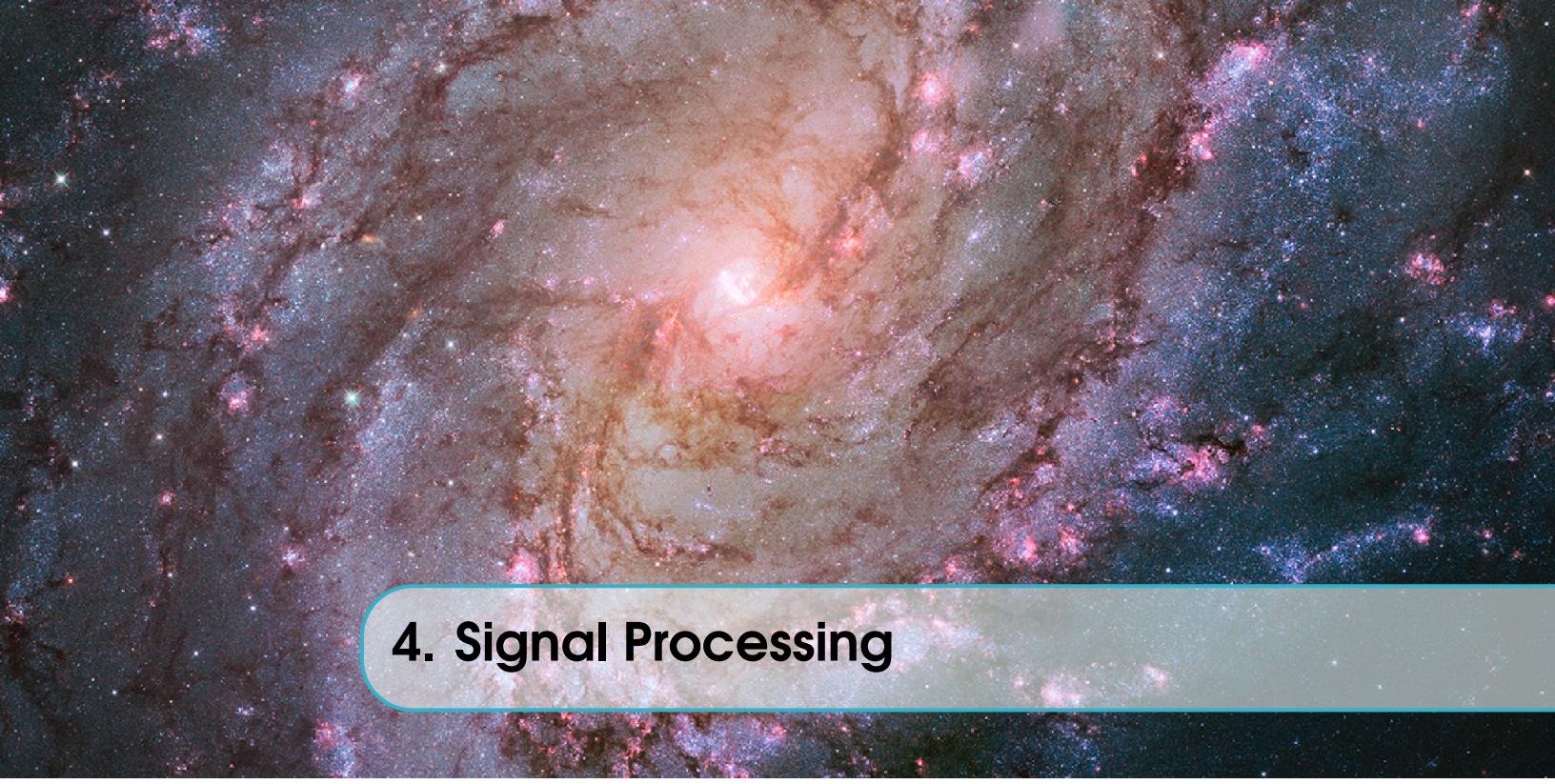
1.2.1 References

Since I found so much good information about pretty much everything I wanted to know about, I will just create a remark and let you know where you can find more specific information about, just like below.

-  For more information about the cosmological principle, review Chapter 1: Why Learn Astronomy?, page 10, from **21st Century Astronomy**, Hester | Smith | Blumenthal | Kay | Voss, Third Edition, 2010.



2. Set Theory: preliminaries



4. Signal Processing

4.1 Complex Numbers

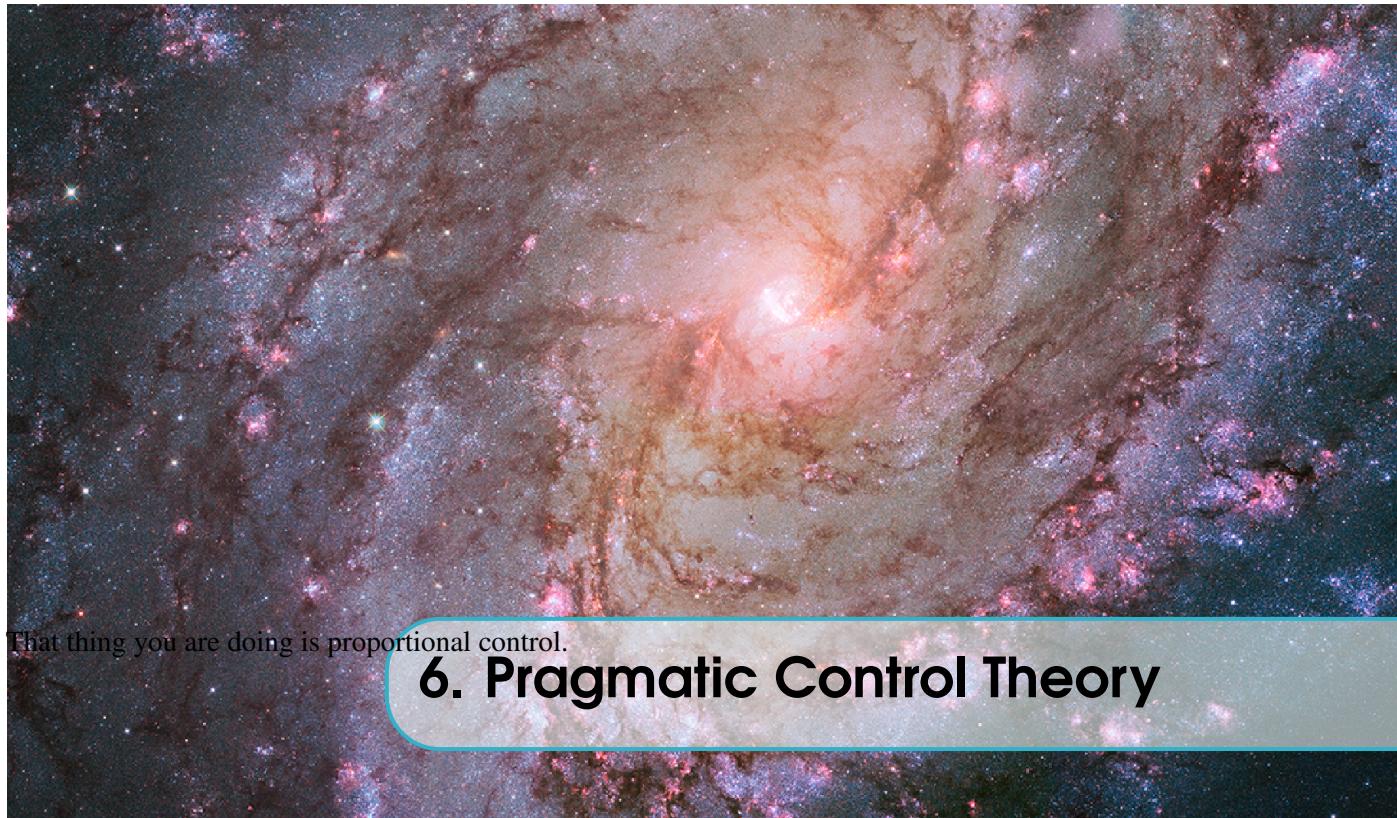
$$z = (x, y) \quad (4.1)$$

$$\operatorname{Re} z = x \quad (4.2)$$

$$\operatorname{Im} z = y \quad (4.3)$$

4.2 Further work

Well, finally we reached the point where my time in Canada finished and this research is still on its first stages. I have so many ideas of how to explore the clustering techniques in the DAME platform, MatLab, Python and everything else that can be tested.



That thing you are doing is proportional control.

6. Pragmatic Control Theory