

ZACHARY DEL ROSARIO

EMBRACING
UNCERTAINTY:
A PRIMER

EMBRACING UNCERTAINTY – A PRIMER

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Introduction

WILLIAM Gibson's masterful short story *The Gernsback Continuum*¹ follows a man haunted by an idea. His protagonist is pursued by *semiotic ghosts*, lingering packets of meaning, there in the form of ray-gun spacemen and ten-engine airships sprung from the mind of legendary science fiction author Hugo Gernsback. This character's dilemma is Gibson's reaction to the starry-eyed view of science fiction in the 1970's – a view stuck in the chrome-plated, streamlined future of the 1930's which could never be.

¹ William Gibson. *Burning Chrome*. Orion Publishing Group, 1986

We as engineers in the early 2000's are haunted by a different idea, that of an engineering certainty which never existed. Our tools are predicated on a deterministic, omniscient view of the universe which is woefully at odds with the reality of our occupation. Our traditional approach is to make uncertainty irrelevant – to pile on margin and arbitrary safety factors until we creep away from failure. This safety comes at the expense of inefficient, expensive designs, and a lack of understanding of the relevant uncertainties, precluding improvement. Underlying this deterministic framework is a sentiment of revulsion, perhaps even fear.

This book is an attempt at exorcism. Rather than making it irrelevant, or becoming paralyzed by anxiety, we aim to *Embrace Uncertainty*.

Purpose

This book is foremost a *primer*. We shall not attempt to cover an exhaustive treatment of all relevant material, but rather shall seek to understand important concepts, and to grasp some useful tools.

The topic is uncertainty, interpreted broadly. Humans, as a species, are generally quite bad at managing uncertainty. At best it tends to make us nervous: Think of the anxiety that strikes when moving to a new city, or asking a stranger on a date. If the outcomes were certain – if finding new friends were guaranteed or our desired would accept – there would be no anxiety. At worst, we tend to ignore uncertainty: Think of politicians who make self-assured² assertions.

² Often self-contradictory...

Anxiety prevents us from taking action. Ignorance prevents us from learning. The foremost objective of this primer is to catalyze a *change in perspective*; to convince you, dear reader, that confronting uncertainty is useful, possible, and necessary.

Furthermore, uncertainty is *exciting*, and helps contribute to a rich, well-lived life. Think of how boring a drama would be if all the plot-points were spelled out before the first establishing shot – amateur critics of films often lament when a movie is predictable. *Reframing* the examples from before, socializing is exciting *because* it is uncertain. As Richard Powers is fond of saying, we should [welcome chance encounters](#). Of course, chance encounters in engineering design are quite unlike those in social dance – a misstep in engineering can cost lives.

With the above waxing philosophic complete, we can fully understand our mission of *embracing* uncertainty as akin to living in the [ideal](#)³ relationship. Just as a successful relationship must be built on mutual respect and continual growth, we as engineers must embrace the uncertainty endemic to our chosen profession, respect and appreciate the unknowns that face us, and continually grow in our understanding. Of course, we ought not take this metaphor too far...

³ non-Hollywood

This book is intended for students of engineering, either early graduate or advanced undergraduate. The content will make modest demands on your background; we will assume fluency with differential and integral calculus. Regretfully, many engineering curricula shortchange probability and (especially) statistics. Both are powerful tools for handling uncertainty, and we will make thorough use of these disciplines. Two appendices are provided to cover the bare essentials of probability and statistics.

How to use this book

Acknowledgements

A great many people have influenced my thoughts on uncertainty, and their influence is reflected in this book. Mike Baiocchi first introduced me to the framing of *embracing* uncertainty, within the context of the reproducibility crisis. It is a testament to the power of language that a simple little phrase can spur a fundamental change in one's philosophy, and I have Mike to thank for this particular thought-germ; one that is still mutating my understanding of the subject.

Bibliography

[1] William Gibson. *Burning Chrome*. Orion Publishing Group, 1986.