1. MOTIVATION AND BACKGROUND

The Design-Oriented Analysis (D-OA) Paradigm

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An Engineer's story

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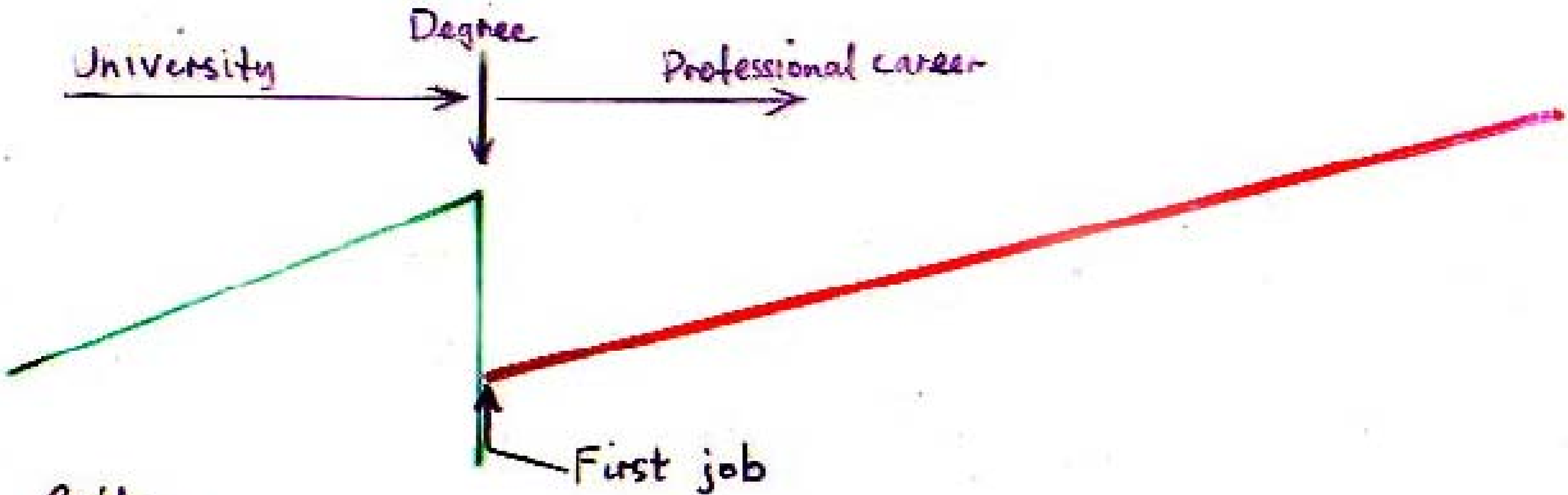
An Engineer's story

Falling off a cliff

Most of us "fall off a cliff" when we begin our first job



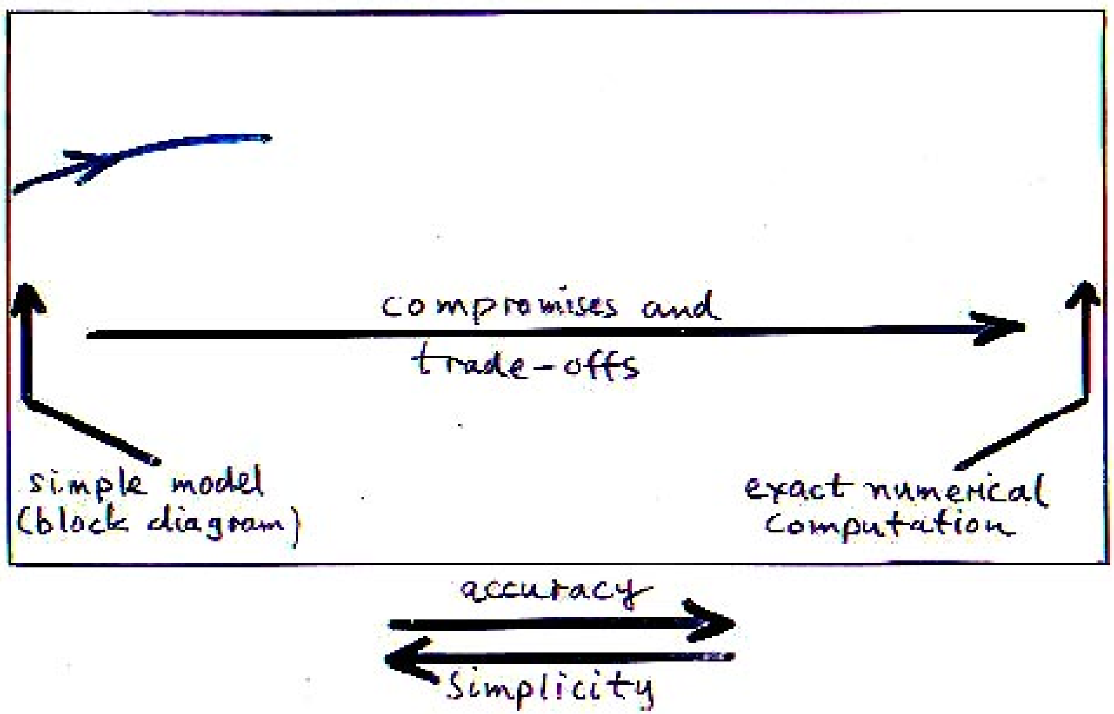
Problem:

New graduate engineers are unable to translate the principles and methods they have learned to the real world.

What can be done?

The Design Process

Design iteration loops



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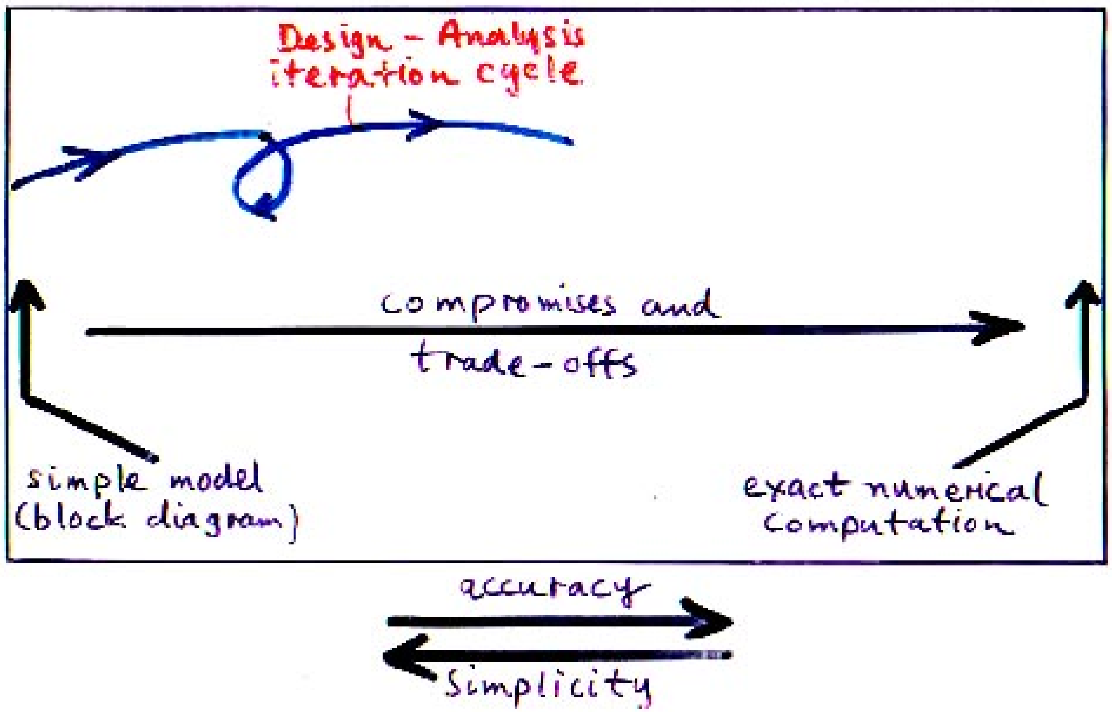

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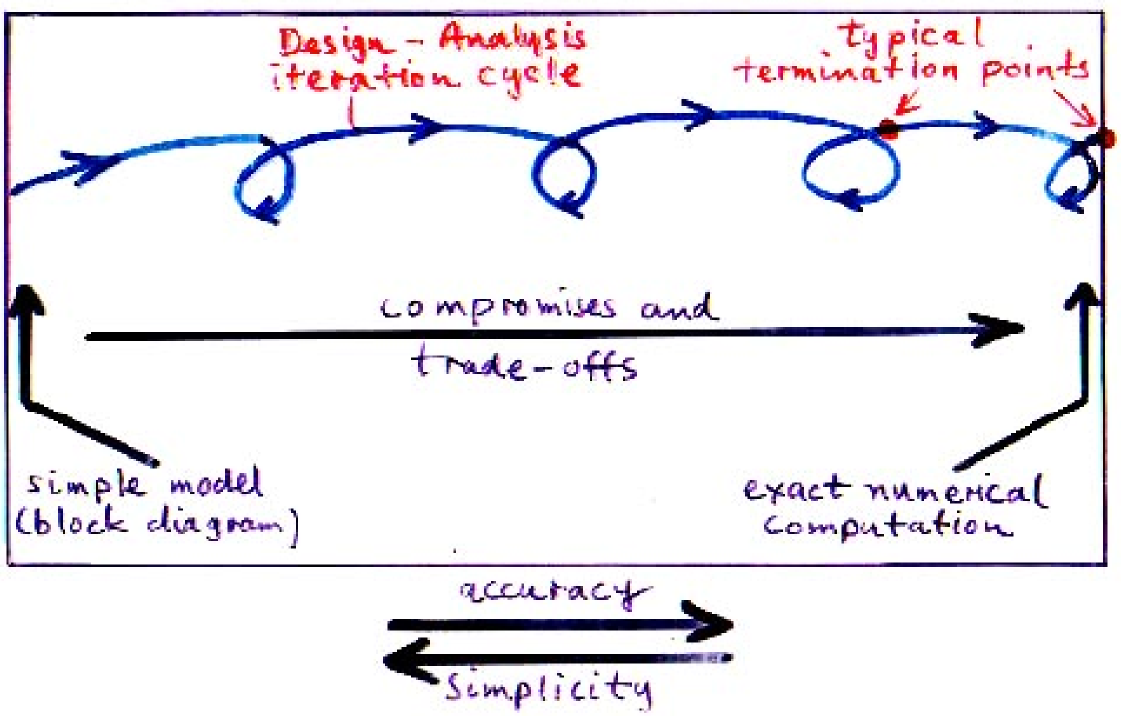
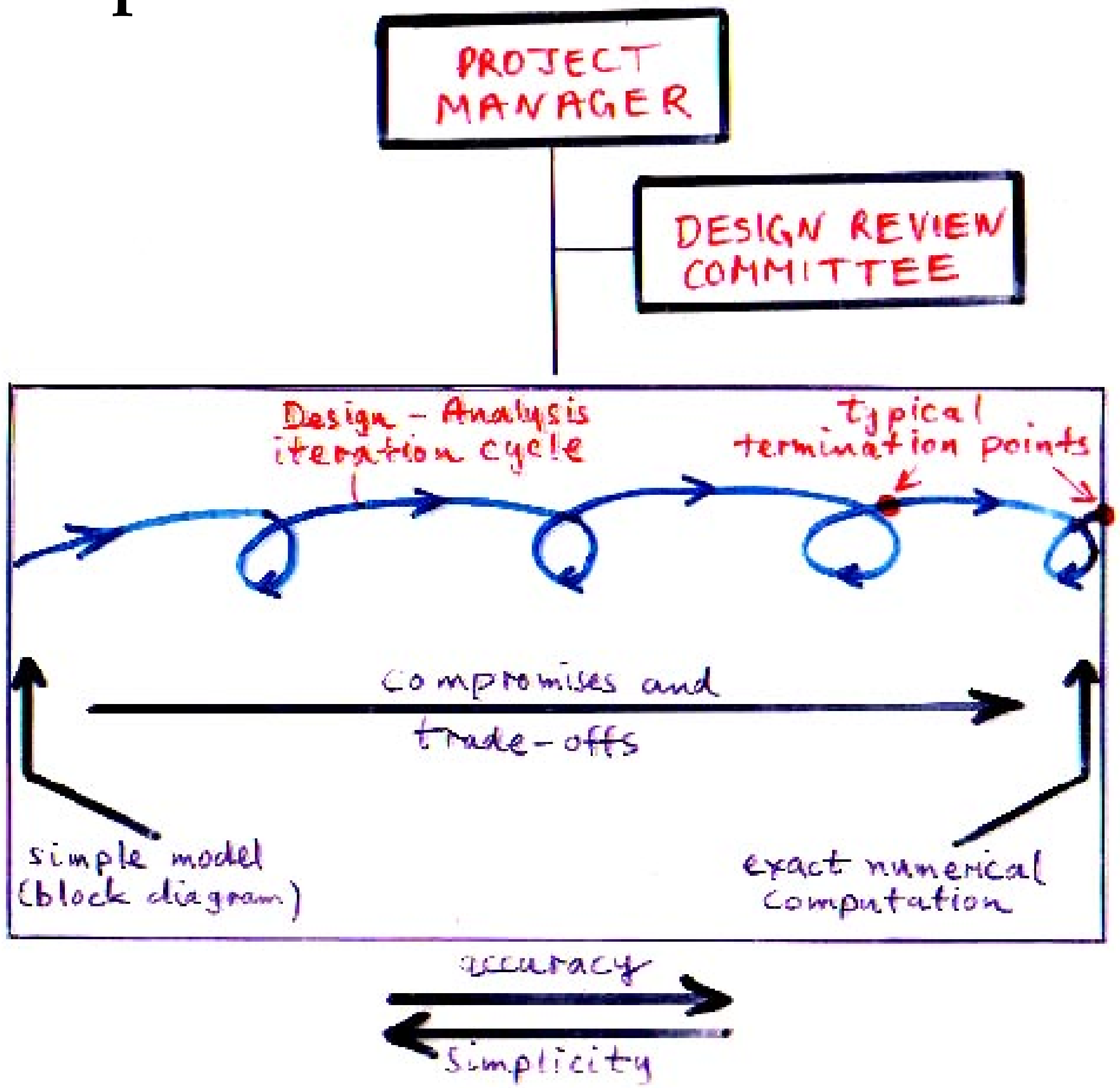


The design process consists of a succession of iteration loops:



"How to present the results" is important:

1. If you are a design engineer writing a report or appearing before a design review committee;

2. If you are a Test, Reliability, or System Integration Engineer dealing with someone else's design.

The D-OA approach is valuable for *all* these engineers.

Realization:

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(the Specification)

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Design is the Reverse of Analysis, because:

The Starting Point of the Design Problem (the Specification) is the Answer to the Analysis Problem

Conventional problem-solving approach:

1. Put everything into the model and simplify later.
2. Postpone approximation as long as possible, and don't even dare to make an approximation unless you can justify it on the spot.
3. The "answer" is acceptable in whatever form it emerges from the algebra.
4. The more work you do, the more valuable the result.
5. Every problem is a brand-new problem, and requires a brand-new strategy to solve it.

This is a recipe for failure!

Syndromes of Technical Disability:

Algebraic diarrhoea, which leads to

Algebraic paralysis

Fear of approximation

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The negative results of the conventional paradigm are often masked while the student is in school.

Why does the conventional approach fail?

Mathematicians tell us:

# of equations must = # of unknowns

Engineers face:

# of equations <<< # of unknowns

but have to solve the problem, anyway.

How can we overcome the negative results of the conventional approach?

1. Divide and Conquer:

It's easier to solve many simpler problems than one large one.

2. We must make the equations we do have *work harder* by expressing them in "Low Entropy" form.

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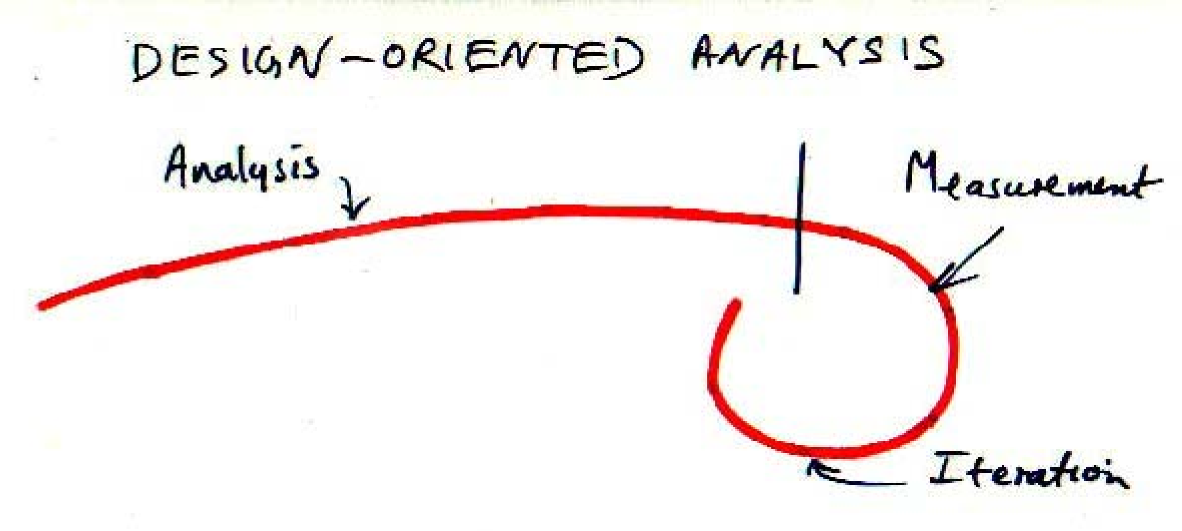
A *Low Entropy Expression* is one in which the terms and element symbols are ordered and grouped so that their physical origin and relative importance are apparent. Only in this way can one *change* the values in an informed manner in order to *change* the analysis answer (that is, to make it meet the Specification).

Low Entropy Expressions are essential in order to navigate the Design Iteration Loop:



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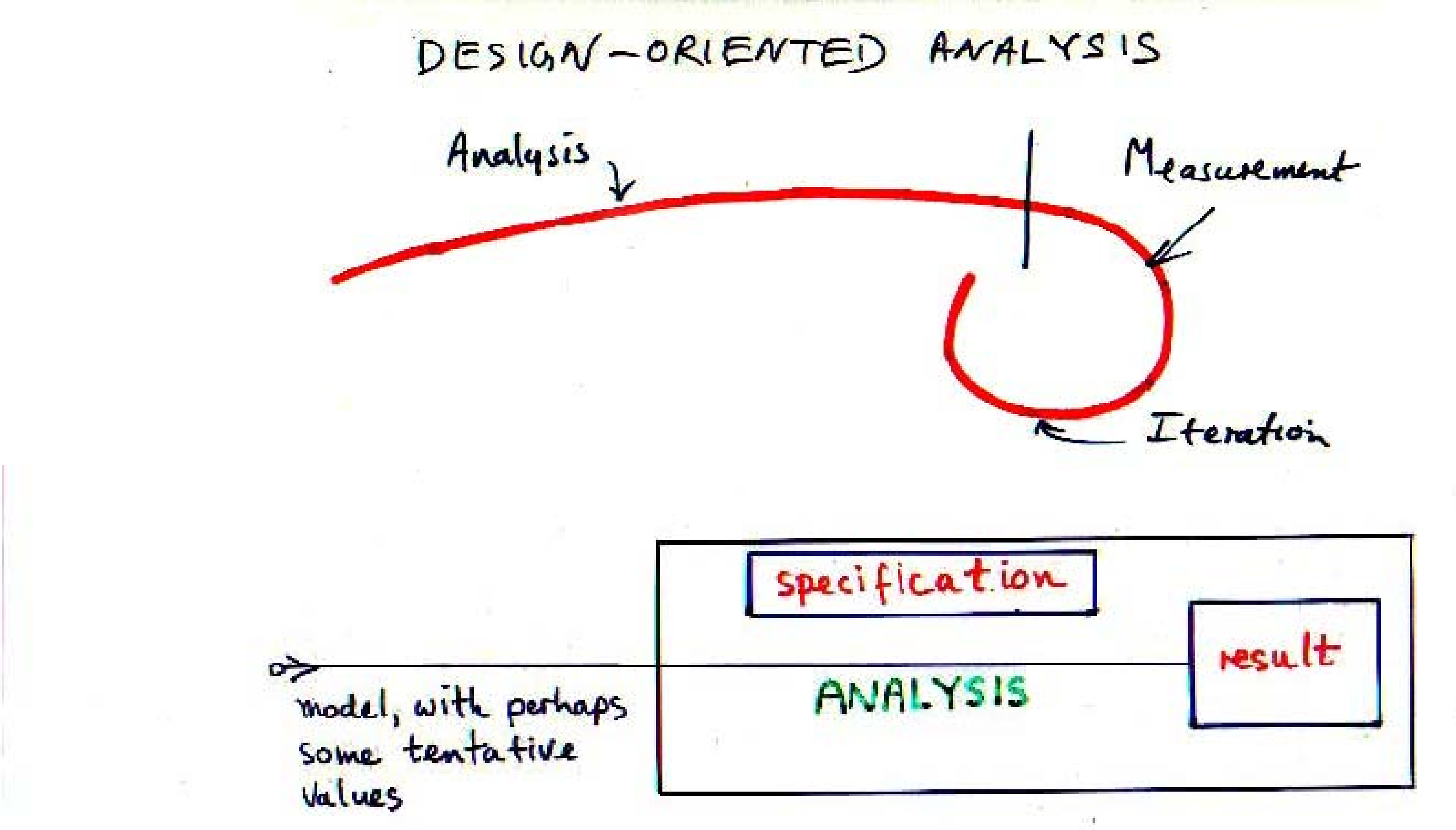

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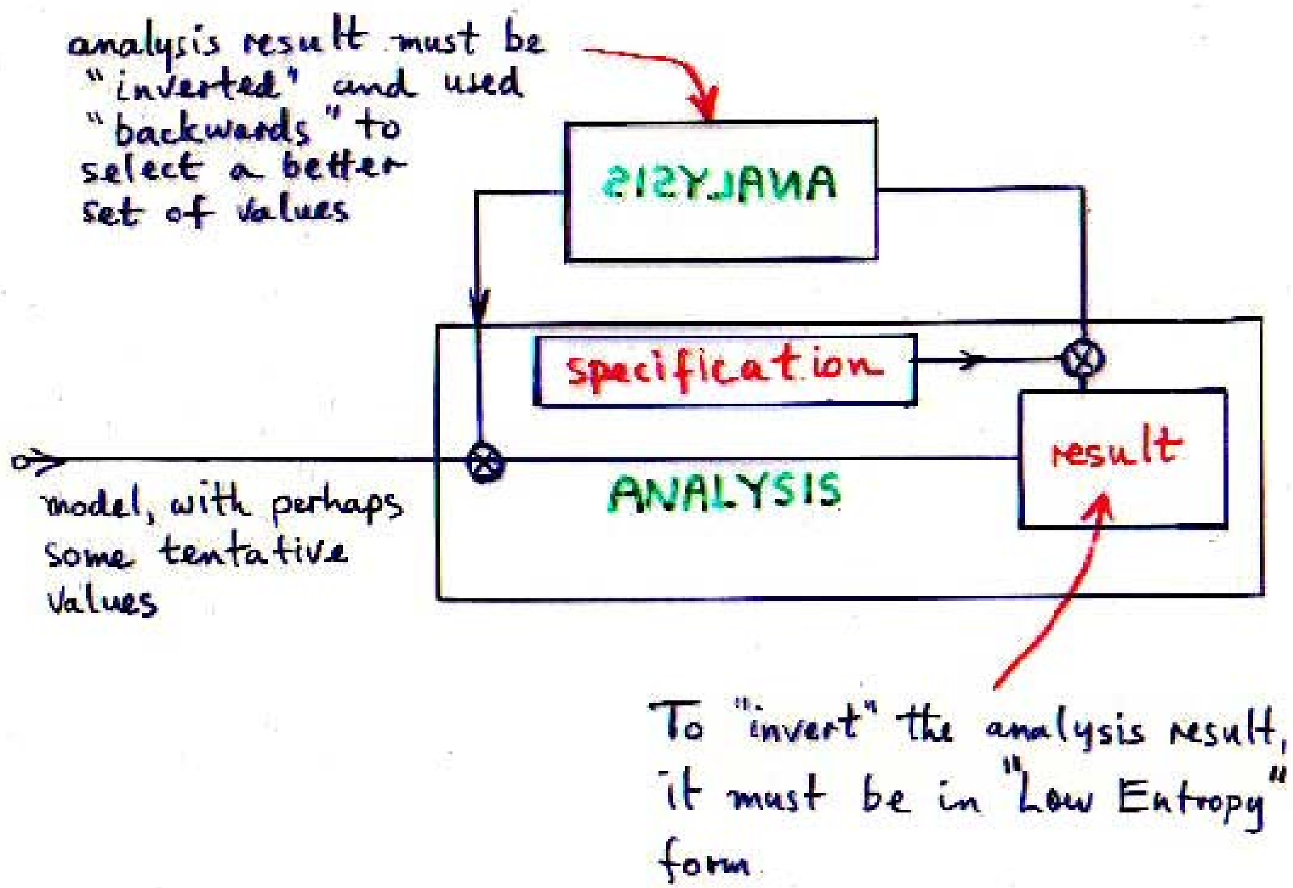

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Avoid multiplying out the series/parallel combinations.

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Therefore, subsititute for the missing equations with: *inequalities, approximations, assumptions,* and *tradeoffs*.

D-OA problem-solving approach: D-OA Rules

1. Put only enough into the model to get the answer you need.

2. Make all the approximations you can, as soon as you can, justified or not. Plow through the problem leaving behind you a wake of assumptions and approximations. ***You can't lose by trying*****.**

3. Figure out in advance as many of the quantities as you can that you want to have in the answer, and put them into the statement of the problem as soon as possible – ***even into the circuit model.***

4. The less work you do, the more valuable the result. ***You*** **control the algebra. You** ***make*** **the algebra come out in low entropy form by applying strategic mental energy before and during the math.**

5. Every problem in not unique. There are problem solving strategies that apply to almost all engineering problems.

This is a recipe for success!

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3. Algebra is *malleable*; you have *choices*.
You are *empowered* to exercise control: the math is your *slave*, not your master.

D-OA is the only kind of analysis worth doing!

TOPIC STRUCTURE

Getting Results:

Low Entropy Expressions
Ch 2

Presenting Results
Ch 3 Ch 4 Ch 5

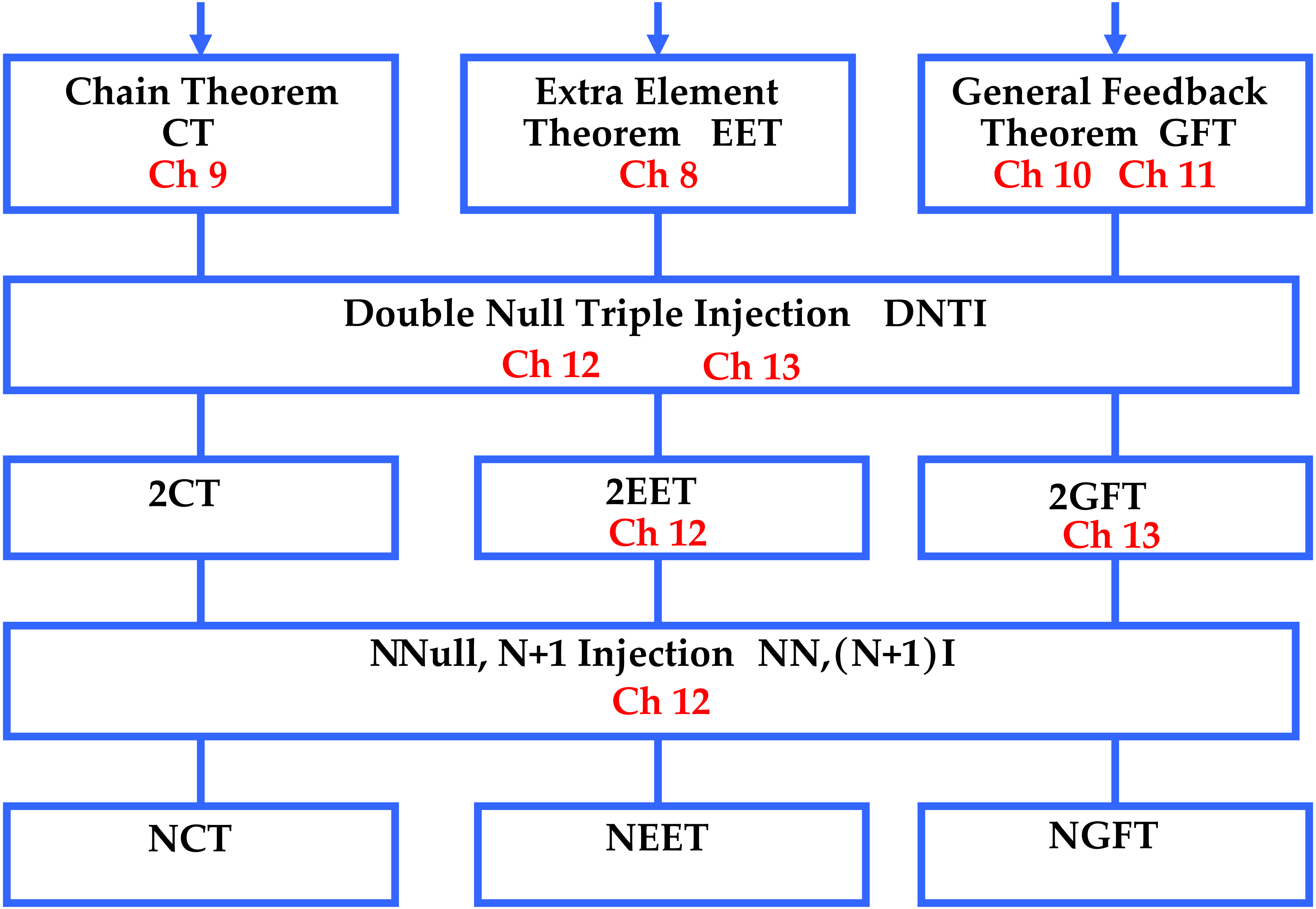
Combining Results
Ch 6

Extending Results:

Input/Output Impedance Theorem I/O IT
Ch 7

Null Double Injection NDI
Ch 8

Dissection Theorem DT
Ch 9



Examples: Chs 14 - 18