Info-Gap Decision Theory
For Design And Planning

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Design and planning of complex systems is invariably based on imperfect models and inaccurate data. The analyst must balance the aspiration for high performance against the need for reliability. This talk explores the unavoidable trade-off between functionality and reliability. We focus on three central ideas.

1. Severely deficient information and understanding can only be quantified by a highly unstructured model of uncertainty. For this we employ **info-gap models of uncertainty** rather than probability. Info-gap models are set-theoretic representations of uncertainty which employ no distribution functions. Info-gap models are axiomatically utterly different from both probability and fuzzy logic, since info-gap models focus on the set-structure of uncertainty rather than on measure-theoretical representations. Info-gap models are particularly suited to representing sparse information since they make no assertions about frequencies of, or beliefs about, rare events.

2. In strategic planning or conceptual design, there is an **irrevocable trade-off between high performance and high immunity-to-uncertainty.** We illustrate this with two heuristic examples. The first is the design of a cantilever subject to uncertain loads. The second is the up-dating of a mathematical system-model based on data. We will touch on the general theorems which underlie these examples.

3. Uncertainty may be either pernicious or propitious, and in designing under uncertainty we should protect against adversity while also enabling the exploitation of opportunities. To do this, we will discuss two **info-gap immunity functions.** The robustness function underlies a decision strategy which satisfices performance and maximizes immunity to failure. The opportunity function supports decisions which "windfall" the performance and minimize the immunity to opportunity. We will touch on the trade-offs and trade-ons which may arise between these strategies.

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