Model-Based Planning for an Uncertain Future: Info-Gap Theory and Some Applications

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Abstract

Quantitative models are used in design and strategic planning in all areas where systematic quantitative analysis is applicable, including engineering, economics, public policy, homeland security, biological conservation, medicine, and so on. Quantitative models bridge the gap between basic and applied science. Science-based modeling gives us the confidence to engage in complex projects and to manage serious risks.

Uncertainty is a major challenge in model-based design. Science-based models employ current knowledge and understanding, while the scientific process is on-going: understanding grows and theories improve. Models are also based on data and insight from the past, and in those areas where historical processes are relevant—such as economics and social planning—the past does not necessarily reflect the future; things can change in fundamental ways.

The practical implication of uncertainty is that we must ask: What outcomes are required? What performance is necessary? Engineers use this approach by asking: What is the design specification? This is different from asking: What is the best possible performance?

When we satisfy a design spec, we seek acceptable performance that may be very demanding but still sub-optimal. This usually means that many design options would satisfy the performance requirement. We can choose the design that is most robust to uncertainty. This strategy is called *robust satisficing:* satisfy the requirements as robustly as possible, choose the design that satisfies the requirements over the largest range of deviation of reality from our current understanding.

In this talk we explain the info-gap theory of robust satisficing, describe its generic attributes, and illustrate its application to infra-structure design and other areas.

Selected References

• Yakov Ben-Haim, 2006, *Info-Gap Decision Theory: Decisions Under Severe Uncertainty,* 2nd edition, Academic Press.

• Yakov Ben-Haim, 2010, *Info-Gap Economics: An Operational Introduction,* Palgrave-Macmillan.

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