Nikolaos I. Ioakimidis, 2021, Application of quantifier elimination to robust reliability under severe uncertainty conditions by using the info-gap decision theory (IGDT), Technical Report No. TR-2021-Q16, 31 pages, July 4, 2021, deposited to Nemertes and appeared online also at Nemertes. DOI: 10.13140/RG.2.2.22065.51041

Abstract Ben-Haim's info-gap (or information-gap) decision theory (IGDT) constitutes a very interesting and popular method for the study of problems in engineering and in many other scientific disciplines under severe uncertainty conditions. On the other hand, quantifier elimination constitutes an equally interesting approach implemented in some computer algebra systems and aiming at the transformation of quantified formulae (i.e. formulae including the universal and/or the existential quantifiers) to logically equivalent formulae but free from these quantifiers and the related quantified variables. Here we apply the method of quantifier elimination (by using its implementation in Mathematica) to the info-gap decision theory and we compute the related reliability regions and, next, the related robustness functions. The computation of the opportuneness (or opportunity) functions is also considered in brief. More explicitly, the four problems studied here concern: (i) the Hertzian contact of two isotropic elastic spheres, (ii) a spring with a linear stiffness but also with an uncertain cubic non-linearity in its stiffness, (iii) the robust reliability of a project with uncertain activity (task) durations and (iv) a gap-closing electrostatic actuator. In all these problems here under uncertainty conditions, the present results are seen to be in complete agreement with the results already derived for the same problems by Ben-Haim and his collaborators (who used appropriate more elementary methods) with respect to the robustness and/or opportuneness functions, but here the reliability regions are also directly computed. Moreover, the present approach permits the study of some difficult parametric cases (e.g. in the problem of the gap-closing electrostatic actuator with a non-linearity in its stiffness), where the help of a computer algebra system seems to be necessary.

Keywords Severe uncertainty, Info-gap, Information-gap, IGDT, Decision theory, Models, Non-probabilistic methods, Robust reliability, Reliability region, Robustness, Opportuneness, Opportunity, Hertzian contact, Spring, Stiffness, Project, Activity paths, Activity durations, Gap-closing electrostatic actuator, Quantifier elimination, Quantifier-free formulae, Mathematica

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