Damage detection systems (DDSs) provide information on the integrity of structural systems in contrast to local information from inspections or non-destructive testing (NDT) techniques. In this paper, an approach is developed that utilizes DDS information to update structural system reliability and integrate this information into risk and decision analyses. The approach includes a novel performance modelling of DDSs accounting for the structural and measurement system characteristics, the damage detection algorithm (DDA) precision including type I and II errors. This DDS performance modelling provides the basis for DDS comparison and assessment in conjunction with the structural system performance including the damage and failure state dependencies. For updating of the structural system reliability, an approach is developed based on Bayesian updating facilitating the use of DDS information on structural system level and thus for a structural system risk analysis. The structural system risk analysis encompasses the static, dynamic, deterioration, reliability and consequence models, which provide the basis for calculating the direct risks due to component failure and the indirect risks due to system failure. Two case studies with the developed approach demonstrate a potential risk reduction and a high Value of DDS Information.

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