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Sections -- Chapter5. 2nd-Order Sensitivities of the PERP Benchmark to the Average Number of Neutrons per Fission -- Chapter6. 2nd-Order Sensitivities of the PERP Benchmark to the Spontaneous Fission Source Parameters -- Chapter7. 2nd-Order Sensitivities of the PERP Benchmark to the Isotopic Number Densities -- Chapter8. 3rd-Order Sensitivities of the PERP Benchmark -- Chapter9. 4th-Order Sensitivities of the PERP Benchmark -- Chapter10. Overall Impact of 1st-, 2nd-, 3rd-, and 4th-Order Sensitivities on the PERP Benchmark's Response Uncertainties.

Sommario/riassunto

This text describes a comprehensive adjoint sensitivity analysis methodology (C-ASAM), developed by the author, enabling the efficient and exact computation of arbitrarily high-order functional derivatives of model responses to model parameters in large-scale systems. The C-ASAM framework is set in linearly increasing Hilbert spaces, each of state-function-dimensionality, as opposed to exponentially increasing parameter-dimensional spaces, thereby breaking the so-called “curse of dimensionality” in sensitivity and uncertainty analysis. The C-ASAM applies to any model; the larger the number of model parameters, the more efficient the C-ASAM becomes for computing arbitrarily high-order response sensitivities. The book will be helpful to those working in the fields of sensitivity analysis, uncertainty quantification, model validation, optimization, data assimilation, model calibration, sensor fusion, reduced-order modelling, inverse problems and predictive modelling. This Volume Two, the second of three, presents the large-scale application of C-ASAM to compute exactly the first-, second-, third-, and fourth-order sensitivities of the Polyethylene-Reflected Plutonium (PERP) OECD/NEO international benchmark which is modeled mathematically by the Boltzmann particle transport equation. It follows from the description of the C-ASAM framework applied to linear systems in Volume One where the PERP benchmark's response of interest is the leakage of particles through its outer boundary. The benchmark represents the largest sensitivity analysis endeavor ever carried out in the field of reactor physics and the numerical results shown in this book prove, for the first time ever, that many of the second-order sensitivities are much larger than the corresponding first-order ones. Currently, the nth-CASAM is the only known methodology which enables such large-scale computations of the exact expressions and values of the nth-order response sensitivities.