# A general approach for decoupling RBDO problems

**André J. Torii[*], Rafael H. Lopez[†], Leandro F.F. Miguel[†]**

[*]Center for Optimization and Reliability in Engineering (CORE), Department of Scientific Computing,
Federal University of Paraíba
Cidade Universitária, s/n, João Pessoa, 58051-900, Brazil
ajtorii@gmail.com

[†] Center for Optimization and Reliability in Engineering (CORE), Department of Civil Engineering,
Federal University of Santa Catarina
Rua João Pio Duarte Silva, s/n, Florianópolis, 88040-900, Brazil
rafael.holdorf@ufsc.br
leandro.miguel@ufsc.br

## ABSTRACT

There are available in the literature several papers on the development of methods to decouple the reliability analysis and the structural optimization to solve RBDO problems. Most of them focused on strategies that employ the First Order Reliability Method (FORM) to approximate the reliability constraints [1]. Despite of all these developments, one limitation prevailed: the lack of accuracy in the approximation of the reliability constraints due to the use of FORM [2]. Thus, in this paper, a novel approach for RBDO is presented in order to overcome such a limitation. In this approach, we use the concept of shifting vectors, originally developed in the context of the Sequential Optimization and Reliability Assessment (SORA) [3]. However, the shifting vectors are found and updated based on a novel strategy. The resulting framework is able to use any technique for the reliability analysis stage, such as Monte Carlo simulation, second order reliability methods, stochastic polynomials, among others. Thus, the proposed approach overcomes the aforementioned limitation of most of RBDO decoupling techniques, which required the use of FORM for reliability analysis. Several examples are analyzed in order to show the effectiveness of the methodology. Focus is given on examples that are poorly solved or even cannot be tackled by FORM based approaches, such as highly nonlinear limit state functions comprised by a maximum operator or problems with discrete random variables. It should be remarked that the proposed approach was not developed to be more computationally efficient than RBDO decoupling strategies based FORM, but to allow the utilization of any, including more accurate, reliability analysis method.

## REFERENCES

[1] R.H. Lopez and A.T. Beck, “Reliability-based design optimization strategies based on FORM: a review”, Journal of the Brazilian Society of Mechanical Sciences and Engineering, 34, 506-514 (2012).

[2] R.H. Lopez, L.F.F. Miguel, I.M. Belo and J.E. Souza de Cursi, “Advantages of employing a full characterization method over FORM in the reliability analysis of laminated composite plates”, Composite Structures, 107, 635-642 (2014).

[3] X. Du and W. Chen, “Sequential Optimization and Reliability Assessment method for Efficient Probabilistic Design”, ASME: Journal of Mechanical Design, 126:225–233, (2004).