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OApackage: A Python package for generation and analysis of orthogonal arrays, optimal designs and conference designs

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Software

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Summary

Orthogonal arrays, optimal designs and conference designs are important tools for the design of experiments (Elster & Neumaier, 1995), (Hedayat, Sloane, & Stufken, 2012), (Wu & Hamada, 2009). The OApackage (Orthogonal Array package) contains functionality to generate and analyse these types of designs. More specifically, the OApackage allows the user to:

- Efficiently generate orthogonal arrays, optimal designs and conference designs
- Reduce the designs to their normal form and perform isomorphism testing
- Calculate a wide variety of statistical properties of the designs

The data analysis of the experiments conducted using the generated designs is left to existing statistical software such as R (R Core Team, 2018) and JMP (Wikipedia contributors, 2018).

To generate orthogonal arrays and conference designs, the OApackage uses an exhaustive generation procedure with isomorphism pruning (Schoen, Eendebak, & Nguyen, 2010), (Schoen, Eendebak, & Goos, 2019). To generate optimal designs, the package uses a flexible optimality criterion and a coordinate-exchange optimization algorithm (Eendebak & Schoen, 2017).

The reduction of the designs to their normal form is done by either reduction to a minimal form (such as lexicographically minimal in columns or delete-one-factor projection normal form (P. Eendebak, 2014)) or reduction using graph algorithms. For designs with a specified isomorphism group, the OApackage provides a generic interface to the graph reduction algorithms that effectively perform isomorphism testing and reduction to normal form.

The OApackage evaluates the orthogonal arrays, optimal designs and conference designs using well-known statistical criteria. For instance, the package can calculate the generalized wordlength pattern and confounding frequency vector (Tang & Deng, 1999), which are based on the J-characteristics (Deng & Tang, 1999), and the number of degrees of freedom available for estimating selected factors' effects. The package can also calculate the F_4 vector of conference designs (Schoen et al., 2019) and the D-efficiency of optimal designs (Goos & Jones, 2011).

The OApackage consists of a C++ library with a Python interface generated by SWIG. The source code is available at https://github.com/eendebakpt/oapackage. Examples for

both generation and analysis of designs are available in the OApackage documentation (P. Eendebak & Vazquez, 2018). The Orthogonal Array package website (P. Eendebak, 2018) contains a large collection of orthogonal arrays, optimal designs and conference designs generated with the package.

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