
rPorta - An R Package for Analyzing Polytopes and Polyhedra

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Summary. In application fields like mechanics, economics and operations research the optimization of linear inequalities is of interest. There are algorithms handling such problems by utilizing the theory of polyhedral convex cones (PCCs) in particular that PCCs can be defined by a span form or a face form. These two representations are called *double description pair* and represent the link between PCCs and linear inequalities. In practice, the transformation from one form into the other is often useful. Here, we present an R package called rPorta providing a set of functions for polytopes and polyhedra mainly intended for the double description pair.

The underlying algorithms used are part of a program named PORTA (Polyhedron Representation Transformation Algorithm) that comprises a collection of routines for analyzing polytopes and polyhedra in general. In particular, it supports both representations of PCCs, i.e. the representation as a set of vectors and as a system of linear equations and inequalities. The main functionality of PORTA is the transformation from one representation to the other, but PORTA also provides other handy routines, e.g. to check whether points are contained in a PCC or not. All functions of PORTA read and write data from text files containing one of the two representations, i.e. the user interface of PORTA communicates through text files. Our package rPorta provides an interface to use the routines of PORTA in R by enwrapping the text file information in S4 Objects. This ensures an easy-to-use and R friendly way to run the functions of PORTA.

In addition, an application of rPorta in design of experiments is presented. In engineering processes the parameter space often contains parameter settings that produce missing values in the design since the produced workpiece fails. The goal is to create a design where the design points concentrate in the feasible area, although the boundaries where missing values are liable to occur are not known. The design is created sequentially and emerging missing values are used to update the excluded failure regions, which is done with the help of PCCs determined with rPorta.