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Data Article

Data for TROTS – The Radiotherapy Optimisation Test Set

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ABSTRACT

The Radiotherapy Optimisation Test Set (TROTS) is an extensive set of problems originating from radiotherapy (radiation therapy) treatment planning. This dataset is created for 2 purposes: (1) to supply a large-scale dense dataset to measure performance and quality of mathematical solvers, and (2) to supply a dataset to investigate the multi-criteria optimisation and decision-making nature of the radiotherapy problem. The dataset contains 120 problems (patients), divided over 6 different treatment protocols/tumour types. Each problem contains numerical data, a configuration for the optimisation problem, and data required to visualise and interpret the results. The data is stored as HDF5 compatible Matlab files, and includes scripts to work with the dataset.

Specifications Table

Subject area	Medicine, Operational Research, Numerical and Multi-Criteria Optimisation

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More specific subject area	Radiotherapy (Radiation Therapy)
Type of data	Numerical data (pencil-beam dose matrices), problem description, patient data (computer tomography (CT) scans, delineations of anatomical structures), scripts
How data was acquired	Simulated dose computation on anonymised CT scan
Data format	Raw and Analysed, in HDF5 compatible Matlab files
Experimental factors	
Experimental features	
Data source location	Erasmus University Medical Center Rotterdam, The Netherlands
Data accessibility	Data is publicly available on our website: http://www.erasmusmc.nl/radiotherapytrots

Value of the data

- The data can be used to evaluate performance and quality of (general) mathematical solvers
- The data can be used to compare different solvers in general or those used in radiotherapy treatment planning
- The data can be used to investigate different multi-criteria optimisation and decision-making approaches in radiotherapy
- The data can be used by groups who want to extend their research interests to radiotherapy, but do not have access to this type of medical data

1. Data

When a patient is diagnosed with cancer and selected for treatment with radiotherapy, a *treatment plan* has to be generated. This is based on a 3D Computer Tomography (CT) scan of the patient, containing delineations of the organs and the tumour. The treatment plan describes the personalised settings of the applied treatment unit, and contains a predicted patient dose distribution for these settings, projected on the CT-scan. The aim is to deliver sufficient dose to the tumour for curation, while keeping the dose to healthy organs as low as possible to minimise the probability of developing radiation-induced treatment related complications.

Computing a treatment plan is a large-scale nonconvex nonlinear combinatorial multi-criterial optimisation problem, to be solved within a limited time-frame, and to acceptable optimality (otherwise the patient might not be treated as well as technically possible). As each patient is anatomically unique, the treatment planning process (optimisation and decision-making) has to be performed for each individual patient.

The data provided allows to investigate two applications: (1) For a chosen problem definition, the performance and accuracy for mathematical solvers can be evaluated, irregardless of the clinical interpretation of the result (see [1]). (2) For multi-criteria optimisation and decision-making (MCDM), different clinical trade-offs can be investigated, irregardless of the performance of the mathematical solver (see [2]).

More information on the technical background of radiotherapy treatment planning can be found in [3,4], and on the use of the data can be found in [1,2,5].