

Particle Therapy Patient Scheduling: First Heuristic Approaches

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1 Test Instances

We created artificial benchmark instances related to the expected situation at MedAustron and real particle treatments. The main characteristic of an instance is its number of therapies n_T . We consider 5 instances for 10, 20, 50, 70, 100, 150, 200, and 300 therapies. In the used naming schema we encode first the number of therapies followed by a consecutive number.

2 Input Format

The instances are encoded in JSON. Note that the instance format described below allows to state instances for a more general problem, hence it contains elements that are not relevant for the Particle Therapy Patient Scheduling Problem (PTPSP). An instance is represented by the following JSON-object:

- **GENERAL**: object, contains globally relevant problem information

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- **H-unit**: not relevant for PTPSP
- **beam-resource-id**: integer, id of the Beam resource
- **proton-resource-id**: not relevant for PTPSP
- **carbon-resource-id**: not relevant for PTPSP
- **IR-rooms**: array of integers, ids of the irradiation room resource, not relevant for PTPSP
- **working-days**: array of arrays of objects, MedAustron working days partitioned into weeks sorted in increasing order of the day index
 - * **d**: unique positive integer, index of day $d \in D'$
 - * **start**: integer, opening time $\widetilde{W}_d^{\text{start}}$ in minutes
 - * **end**: integer, closing time $\widetilde{W}_d^{\text{end}}$ in minutes
- **RESOURCES**: array of objects, all resources and their availabilities
 - **id**: unique positive integer, resource id
 - **name**: string (optional), name for resource
 - **scatter**: not relevant for PTPSP
 - **W**: array of objects
 - * **d**: unique integer, day d
 - * **start**: integer (optional, default: $\widetilde{W}_d^{\text{start}}$), start time $W_{r,d}^{\text{start}}$ in minutes
 - * **end**: integer (optional, default: $\widetilde{W}_d^{\text{end}}$), end time $W_{r,d}^{\text{end}}$ in minutes
 - * **unavailable**: array of objects (optional), unavailability periods
 - **start**: start time $\overline{W}_{r,d,w}^{\text{start}}$ in minutes
 - **end**: end time $\overline{W}_{r,d,w}^{\text{end}}$ in minutes
- **THERAPIES**: array of objects, all therapies with their data
 - **id**: unique positive integer, therapy id
 - **name**: string (optional), name of the therapy
 - **n-twmin**: integer (optional, default: 4), minimum number of treatments per week n_t^{twmin}
 - **n-twmax**: integer (optional, default: 5), maximum number of treatments per week n_t^{twmax}
 - **delta-min**: integer (optional, default: 1), min. number of days between two consecutive DTs δ_t^{min}

- **delta-max**: integer (optional, default: 5), max. number of days between two consecutive DTs δ_t^{\max}
- **daily-treatments**: array of objects, all DTs are given in the required order
 - * **id**: unique positive integer, DT id
 - * **name**: string (optional), name of DT
 - * **d-min**: integer (optional, default: 1), earliest possible day $d_{t,u}^{\min}$
 - * **d-max**: integer (optional), latest possible day $d_{t,u}^{\max}$; if not specified or -1 no bound is assumed (an implicit limit is given through the number of considered days)
 - * **activities**: array of objects, all activities that must be scheduled in this order at a single day
 - **id**: unique positive integer, activity id
 - **name**: string (optional), name of activity
 - **p**: positive integer, processing time $p_{t,u,a}$ in minutes
 - **resources**: array of integers (optional), id's of required resources
 - * **min-lag**: array of objects (optional), minimum EtS time lag constraints
 - **a1**: integer, id of first activity a
 - **a2**: integer, id of second activity a'
 - **time**: integer, minimum EtS time lag $L_{t,u,a,a'}^{\min}$ in minutes
 - * **max-lag**: array of objects (optional), maximum EtS time lag constraints
 - **a1**: integer, id of first activity a
 - **a2**: integer, id of second activity a'
 - **time**: integer, maximum EtS time lag $L_{t,u,a,a'}^{\max}$ in minutes