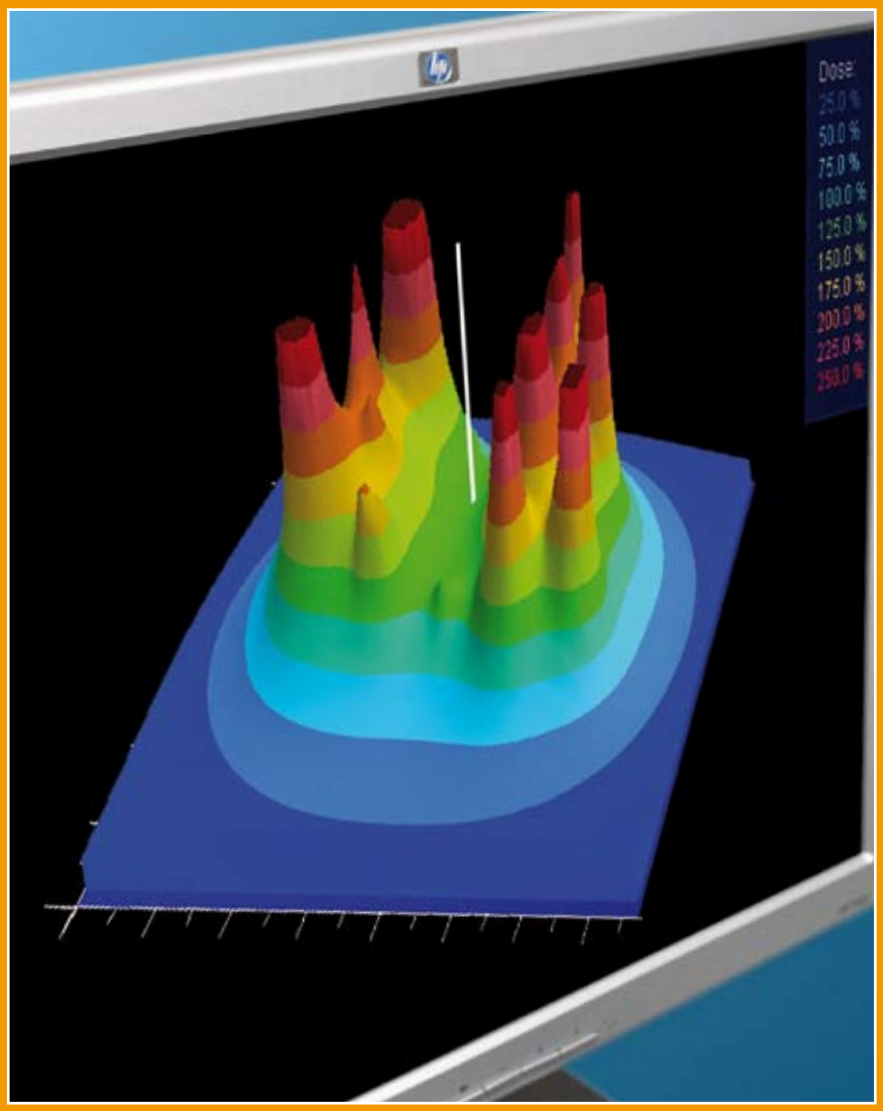



Accuracy & Speed
Advanced optimization technologies

# Oncentra Prostate

Oncentra
By Nucletron

# Accuracy & Speed
# Advanced optimization technologies

In the treatment of prostate cancer with brachytherapy, time is becoming an increasingly important factor. Clinical practice shows that radiation oncologists are looking for a system that is able to define the optimal target dosimetry, while sparing organs at risk and preventing high toxicity levels; and all of that in the shortest possible time.

Nucletron's Oncentra Prostate*, the fully integrated real-time system for HDR prostate brachytherapy, now offers optimal dose conformity and dose homogeneity in just a matter of seconds. Oncentra Prostate is the only dedicated real-time system for HDR prostate brachytherapy that offers the optimization technology needed to fulfil the whole spectrum of clinical needs.

*Abbreviations:*

*CTV – Clinical Target Volume*
*CTV3 – Visible tumor infiltration areas within CTV*
*DVH – Dose Volume Histogram*
*DVHO – Dose Volume Histogram Optimisation*
*GTV – Gross Tumor Volume*
*HDR – High Dose Rate*
*HIPO – Hybrid Inverse Planning and Optimisation*
*PTV – Planning Target Volume*
*VBO – Variance Based Objective*

** Formerly known as SWIFT*

The family of most advanced and time sparing optimization technologies is the anatomy-based inverse optimization, which consists of two engines: the VBO and the DVHO.

### VBO anatomy-based inverse optimization

This is the fastest available engine for realizing anatomy-based optimization in Brachytherapy. In a few sub-seconds the engine considers multiple targets and several organs at risk, based on a variety of objective functions. These functions are CTV and several GTV's, or equivalently CTV 3. VBO can be considered a realtime optimization engine. For users with experience in the well-known dose point based optimization that is available in Plato BPS (also available in Oncentra Brachy), VBO offers the smoothest path for moving towards a real anatomy-based inverse optimization. VBO also enables the consideration of dwell time gradient restrictions for each catheter separately and offers dose distributions that are highly conformal to the target volume. This results in the minimum possible dose outside of the target volume. VBO handles the dose conformity (the concentration of dose to the target) and homogeneity objectives for the target and secures a dose limit, which is called a high dose constraint, for each of the considered organs at risk.

### DVHO anatomy-based inverse optimization

DVHO is a unique implementation of DVH-based inverse optimization technology. DVHO is the fastest available engine for HDR Brachytherapy optimization with the use of linear penalization. In addition to target volume (CTV or PTV) several GTV's (CTV3) and several organs at risk can be considered simultaneously. For the target volume(s) a dose-window is defined: the low and high dose limit. A high dose limit is

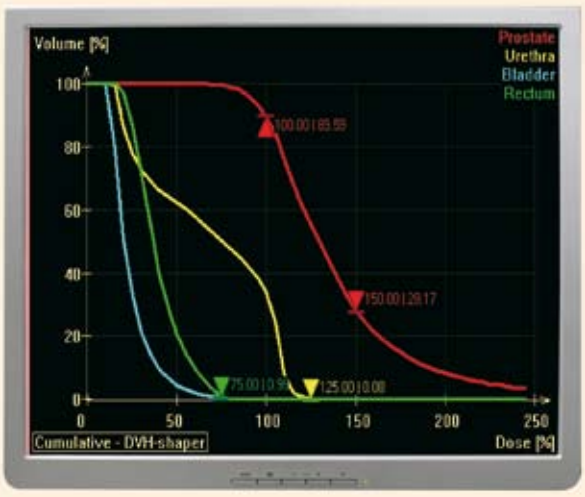
considered for each of the organs at risk. DVHO offers a user-friendly interface for carrying out DVH-based inverse optimization. Next to that, the high speed of DVHO enables interactive optimization.
DVHO offers a dwell time gradient restriction filter in order to account for clinical constraints within the catheters. It is the only tool in this category of optimization that offers this possibility, which is comparable to VBO. This enables the creation of better security in the delivery dose distributions without having to compromise to the optimization performance. Especially regarding the coverage of the target volume, DVHO offers better flexibility in shaping the 3D dose distribution than the VBO engine.

Oncentra Prostate enables users to implement and store all clinical protocols that are available. This minimises the number of user interactions and inputs needed during treatment planning and especially during the treatment plan optimisation. Oncentra Prostate can be automatically adapted to the presets and specifications of these clinical protocols. A predefined protocol can be selected, enabling homogenisation of the planning procedure and increasing compatibility among several users of the system. All parameters that are needed for the VBO or DVHO optimization engines are also part of the protocol (preferences) and are automatically set to the protocol-defined values.

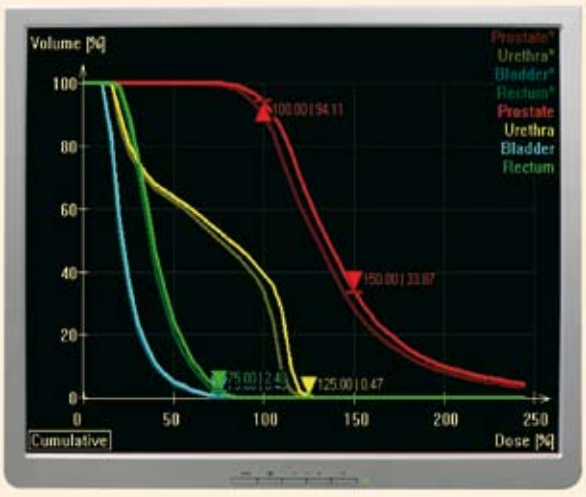
## DVH-Shaper

The DVH-Shaper is a unique graphical user interface, which enables users to interact with the optimization engine, either VBO or DVHO, directly through the DVH graphs. It offers a user-friendly interface to allow for interactive optimization while considering dose or weight penalties, or importance factors. The user simply sets the adaptation of a DVH curve for any target or organ at risk. The system then takes care of the mathematics itself.

The DVH-Shaper, in combination with the 'history' and 'lock' functions, offers a unique and secure platform for interactive DVH-based optimization, minimizing the learning curve for the user.




*DVH-Shaper with the DVHO optimization engine, considering one target (prostate with low and high dose limits) and three organs at risk (urethra, bladder, rectum each with a high dose limit). Dose limits are shown as triangles on the DVH curves. By moving a triangle up or down DVHO runs and adapts the DVH accordingly.*




*DVH-Shaper in combination with the history and lock tools and DVHO engine. Thin DVH lines show the locked DVHO optimization shown in the figure above. The user increased the coverage of the target. The resulted DVH's (thick lines) clearly demonstrate that a further increase of coverage can only be achieved on the cost of the other objectives (high dose limit for target and organs at risk).*

## HIPO

HIPO stands for Hybrid Inverse Planning and Optimization. With the DVHO engine and a stochastic method for adapting catheter placement, HIPO enables the automatic placement of a specific number of catheters, defined by the user, in such a way that all selected objectives are realised in the most effective way. It is a unique tool for inverse planning in HDR prostate treatment.

Taking into account all selected objectives and dose limits, HIPO starts with an initial placement of catheters. This placement is adapted to the patient anatomy. The fast DVHO algorithm adapts the catheter position on the spot in order to achieve the implant setup that best realizes all objectives. For each catheter configuration HIPO runs DVHO and evaluates the 3D dose distribution, taking the differences of all user-selected dosimetry objectives into account

HIPO enables the realisation of all possible clinical scenarios. The user can propose an initial catheter placement and ask HIPO for improvement. The user may also define catheters that are to be used in any case and ask HIPO for the most appropriate additional catheter(s). At any moment the user may decide to stop HIPO and intervene by introducing changes. In that case, HIPO will reallocate the most efficient implant positions.

HIPO runs in the clinically comfortable time of one up to three minutes, making the intra-operative preplanning of a prostate implant effective and user-independent.

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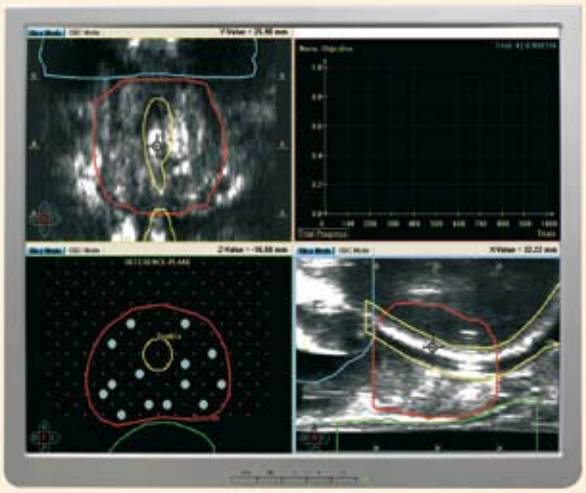
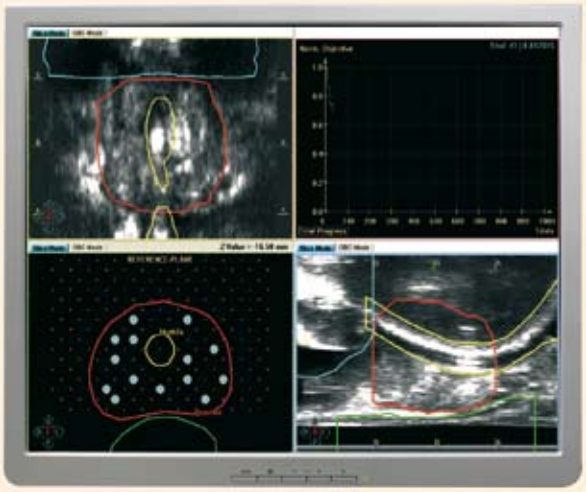


*Oncentra Prostate during execution of HIPO. At the lower left window the current catheter configuration is shown, where in the upper-right window user can follow the progress of HIPO trials.*

1.



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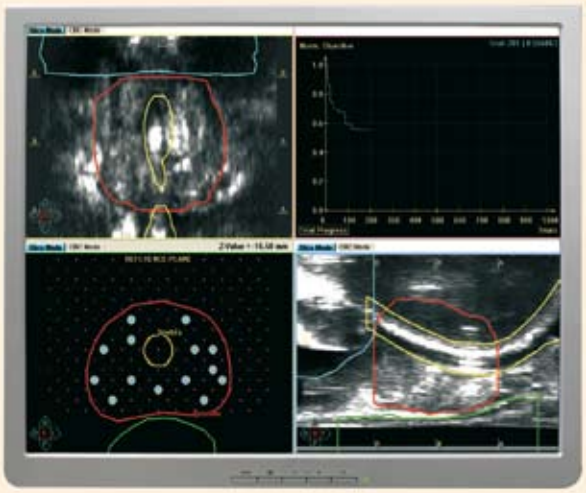

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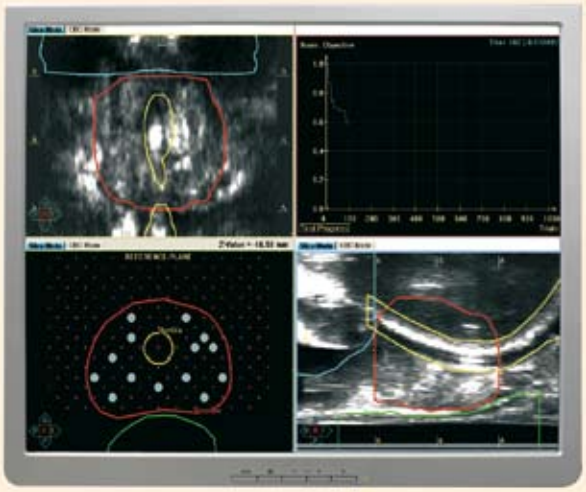

*Oncentra Prostate screenshots with HIPO running, after 4 trials (1), after 41 trials (2) and after 102 trials (3). The adaptation of catheter placement for continuously improving the value of the objective function is clearly demonstrated. In this example, running for an automatic placement of 14 catheters and considering dosimetry limits (objectives) for target (low and high), urethra (high), rectum (high) and bladder (high), HIPO needed 36 seconds for 102 trials with an equivalent number of DVHO-optimizations involved (Intel Pentium 2.1 GHz processor and 1 GB RAM).*

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