SRW Development Notes – Propagation Parameters

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**Description of Propagation Parameters**1

1. Auto-Resize (1) or not (0) Before propagation.
2. Auto-Resize (1) or not (0) After propagation.
3. Relative Precision for propagation with Auto-Resizing (1.0 is nominal).
4. Type of the propagator:

* 0 - Standard - Fresnel (it uses two FFTs);
* 1 - Quadratic Term - with semi-analytical treatment of the quadratic (leading) phase terms (it uses two FFTs);
* 2 - Quadratic Term - Special - special case;
* 3 - From Waist - good for propagation from "waist" over a large distance (it uses one FFT);
* 4 - To Waist - good for propagation to a "waist" (e.g. some 2D focus of an optical system) over some distance (it uses one FFT).

1. Do any Resizing on Fourier side, using FFT, (1) or not (0).
2. Horizontal Range modification factor at Resizing (1.0 means no modification).
3. Horizontal Resolution modification factor at Resizing (1.0 means no modification).
4. Vertical Range modification factor at Resizing (1.0 means no modification).
5. Vertical Resolution modification factor at Resizing (1.0 means no modification).

**Current Issues**

* In order to ensure convergent results with acceptable resolution, propagation parameters need to be tuned for each optical element in an SRW simulation Properly defining the propagation parameters for a given simulation is difficult at each interface of the code (Python, Sirepo..).
  + This difficulty increases with the complexity of the beamline as each beamline element (including free space drifts) requires its own set of propagation parameters.
* The “Auto-Resize” function built into SRW attempts to automatically optimize propagation parameters.
  + This function does not always work for the standard Fresnel propagation method and does not work at all for the semi-analytic “Quadratic Term” propagation method.

**Plans to Optimize Propagation Parameters**

* Create and document example simulations in which auto-resize fails to produce acceptable results.
  + Examples may include a simple drift or a one-to-one focusing beamline.
* Begin to develop parameter optimization methods for Gaussian beams and then consider more complex profiles (e.g. undulator radiation).
* Use the map method formulation to quickly create reduced models and predict propagation parameters based largely on beam sizes, Sigma matrices.
* Implement functionality for users to achieve results with relative uniformity at any point on the beamline.

**References:**

[1] <https://github.com/radiasoft/sirepo/wiki/SRW-Propagation-Parameters>