UV Branch Driver Model

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Overview:
This model of the driver for the Ultraviolet (UV) wiggler branch of the Free Electron Laser (FEL) at Jefferson Labs (JLab) is a modification of the model of the driver for the currently operational Infrared (IR) wiggler branch. The original model, which simulates rudimentary (linear) optics with a series of Microsoft Excel Worksheets, simply had to have the elements which differ between the UV and IR branches updated to reflect that change, to present the new beamline. To ensure the correct operation of this model, the attributes of the beam-line elements and LINAC injection betas were set to that of the DIMAD data.

Elements: Sequential list of beamline elements to input into optical calculations, with the attributes of each element contained within the row and to its right (as the examples line 21 through 30 portray). The elements in the UV model of the driver reflect the branches of travel that differ from the IR and those that do not.
Combobox controls allow one to manipulate the quadrapole strengths and immediately see the results in the betas. As new quadrapoles were added, others deleted and moved, these values had to be updated in the UV model. The nominal presents the length attribute of the quadrapole (column B) * the rigidity (lime green cell above quadrapole) * the default strength, k1 (based on DIMAD model). The set reflects this and the offset, upon which the element attributes k1 are based on, by dividing by length and rigidity. (in the screenshots, as the offset is 0, the nominal and set are equal and the strength of each quadrapole is the default strength presented by the DIMAD model).
Matrices: Sequential list of matrices of which the input and formula type are based on the corresponding row in the elements worksheet. These are 6x6 matrices, (as the highest number of attributes in a beamline element is six,) with each element of the matrix listed left to right in a senary (heximal) system. A simple copy-paste of one matrix row to another matrix row that shares the same type of beamline element (and therefore matrix formula) is all that is needed to reflect changes in beamline elements. For the purposes of saving organizational space, the final transfer matrix from the products worksheet of wiggler.xls, a workbook dedicated solely to the wiggler, is used. The attributes of the elements in wiggler.xls are likewise based on the DIMAD model and the worksheets are similarly calculated and organized.
**Products:** “Contains a cumulative product of the linear transfer matrix through the beam line. [1]” This updates automatically, because the cell formulas are independent of their input values (they can be AutoFilled) and are based solely on matrix mathematics.
Betas: “Contains a table of beam envelopes, dispersions, and phase advances; these data are presented graphically on the elements [and emittance] worksheet[s]. [1]” Comparing the UV values to those of the DIMAD model verified the correct operation of the worksheet (given that the LINAC injection values and quadrupole strengths are equivalent).
Orbits (rotated 90 degrees): Compares calculated ray-trace data to BPM feedback from different orbit measurements and “controls simulating the effect of correctors on the orbit are provided. [1]” This would be used in the operation of the model of the UV driver in conjunction with the actual UV branch of the FEL. It could be said to serve as the final test for both systems.
**Emittance:** “Contains a table propagating the beam matrix, fields to enter measured spot sizes, and fit functions [using Solver] to reduce the data when performing multi-monitor emittance measurements. Propagated and measured spot sizes \((\sigma)\) are, as with other data, presented graphically [1].”

References