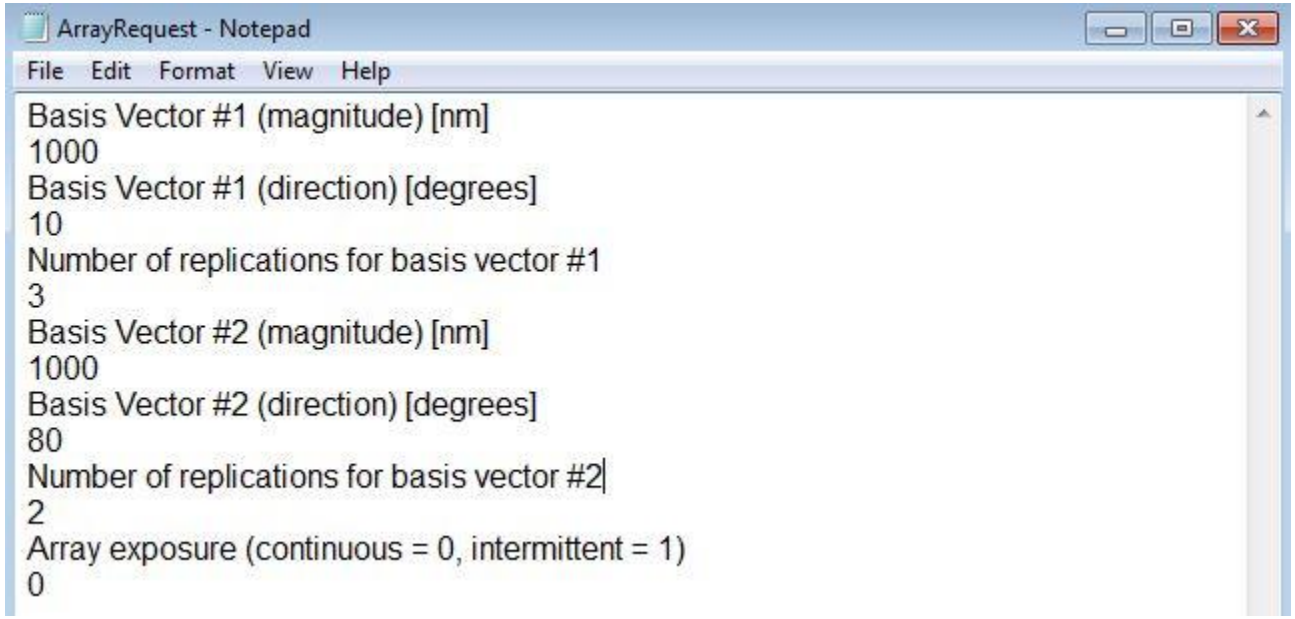
Method #6: Array exposure

Video: Method #6 (Array exposure)

A text file named “ArrayRequest.txt” is located in the main folder \EBiD 3D (CAD) and is used in concert with the GUI to create a 2D array that contains duplications of the 3D object defined in the design folder. The ArrayRequest.txt file has the following format;



The array is defined using two basis vectors. Each basis vector is characterized by a magnitude and rotation angle with respect to the x–axis. A positive rotation angle indicates a counter clockwise rotation. The array is created using the following format;

$$\sum_{m=0}^{M-1}\left[\sum_{n=0}^{N-1}(n\cdot|\vec{v}_1|cos\theta_1+m\cdot|\vec{v}_2|cos\theta_2, n\cdot|\vec{v}_1|sin\theta_1+m\cdot|\vec{v}_2|sin\theta_2)\right]$$

where the magnitude of basis vector 1 is $\mathbf{v}_1$, the rotation angle is θ_1 and the number of nodes along this direction is N. Similarly, basis vector 2 is defined by $\mathbf{v}_2$, θ_2 and M. The final parameter defined in the file is the array exposure mode. “Array continuous” indicates that the 3D objects will be exposed one at a time by FEBID. Conversely, in the “array intermittent” mode the objects will be exposed together. The latter mode favors the electron limited regime (ELR) during FEBID but is susceptible to beam drift for the case of a large array containing many 3D object replications. Figure 1 below shows the sequence of events that takes place during array creation. Array creation is launched during exposure file creation, i.e., when the “BuildCAD” button is pressed if the “Array ?” checkbox is selected on the GUI.

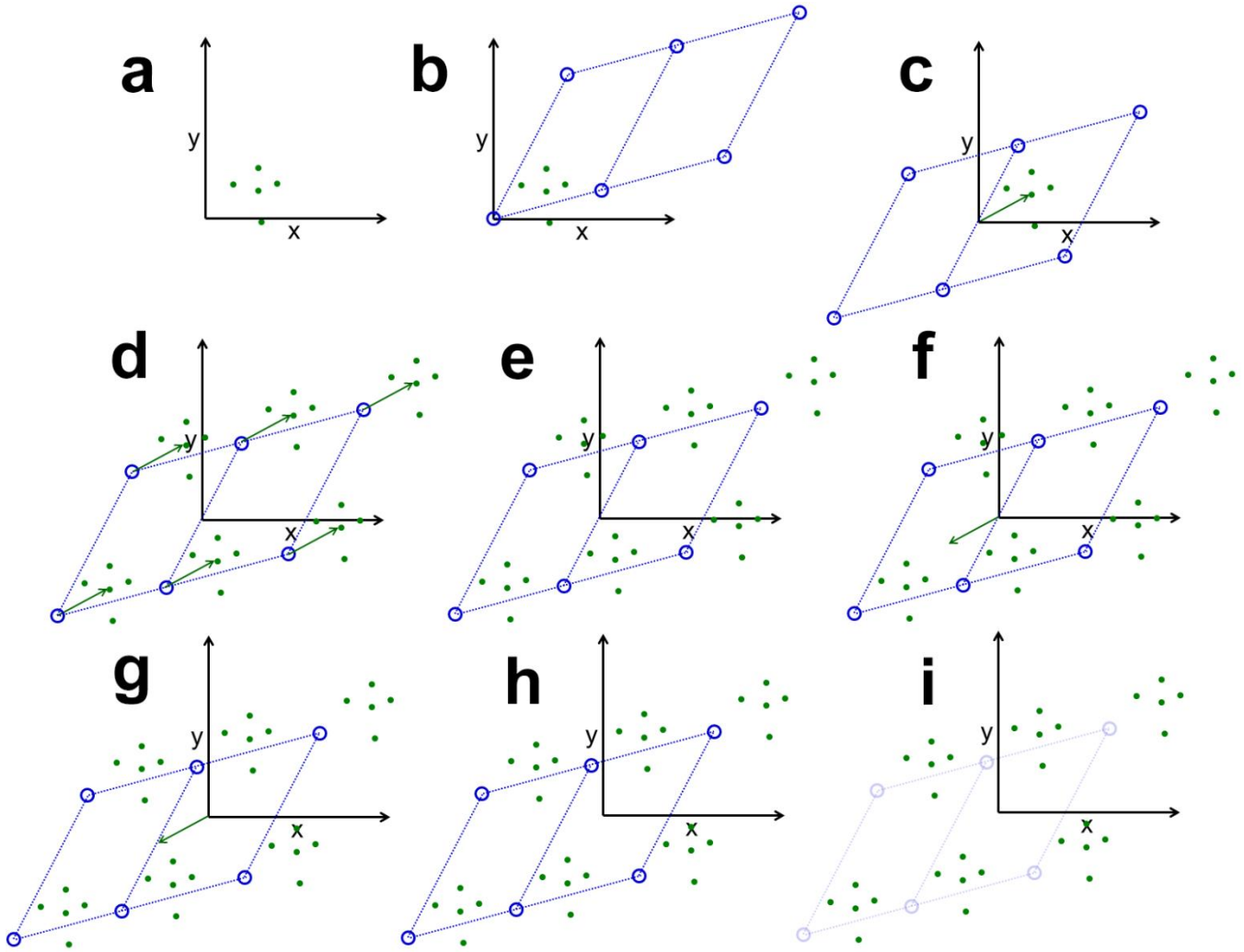


Figure 1

Figure 1 shows the step-by-step sequence of events that takes place when the array exposure is executed. This process is presented in detail because it will help the User determine the absolute position of the 3D object coordinates in the event that in–plane alignment is critical. Figure 1a shows a top-down image of the absolute position of a set of vertices that define a 3D object in the GUI. Pillar/segment elements have been excluded to avoid clutter. The array coordinates are initially loaded into the same coordinate system (figure 1b) as defined by the provided basis vectors in ArrayRequest.txt. The average value of the (x) and (y) values of the array coordinates are calculated and these values are subtracted from each array point (figure 1c). The 3D object is duplicated and translated to each array coordinate (figure 1d-e). A final shift of the arrays is

executed based on the mean (x) and (y) coordinate for the original 3D object (figure 1f-g). This completes the centering operation for the array (figure 1h) and the final array with 3D object duplicates is shown in figure 1i.

In the example provided with this Method, the “array continuous” exposure mode was selected. In this mode, exposure presidence is placed on the first basis vector, followed by the 2nd basis vector, yielding the order of exposure shown in Figure 2.

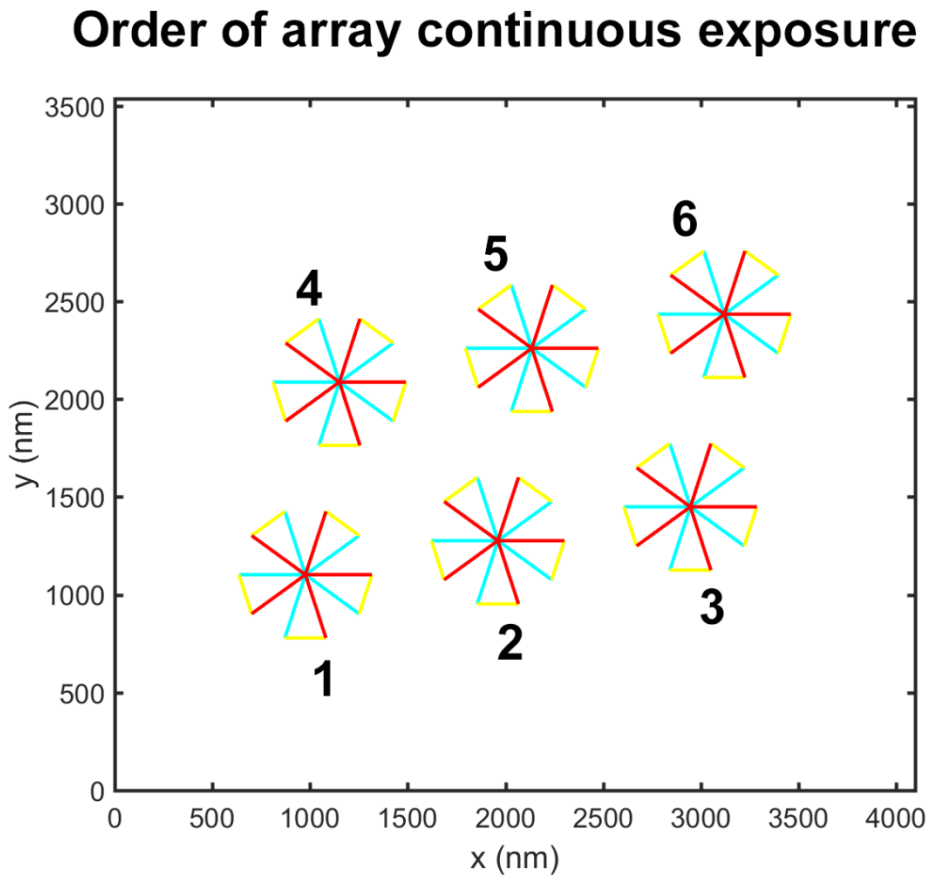


Figure 2