Finding Mirror Inclination Angles for Solar Mirror Arrays

Anyone that has attempted to position the mirror elements for a multifaceted mirror array for a solar furnace knows that it can be a dangerous and imprecise effort. After failing to find a suitable formula in the math books, it was necessary to derive it. A formula has been derived to calculate the facet inclination from its' distance from the focal axis and the focal length of the array. Anyone with the interest and ability is asked to confirm the result. It also might serve as a suitable exercise for High School Trigonometry teachers to give their students.

If a radial array of mirrors is to be built only one calculation of inclination needs to be made . That calculation only depends on the distance between the mirror facet and the focal axis of the array.

From the law of reflection of plane mirrors it can be shown that the inclination between the array plane and the reflected ray depends on the focal axis distance and height of the receiver:

$$\text{Arc Tan}(F/X)$$

From the diagram"Array Geometry" , Euclidean Theorems and Newtonian Optics two equations in two unknowns can be derived:

$$2(I) + \text{Arc Tan}\,(F/X) = 90^\circ$$
$$(U) + (I) + \text{Arc Tan}(F/X) = 90^\circ$$

The expression *Arc Tan (F/X)* can be treated as a constant, as it will depend only on the focal length and radial distance of any particular mirror.

Solving for U

$$U = 45^\circ - \tfrac{1}{2}\,\text{Arc Tan}\,(F/X)$$

By using this formula in a spreadsheet program the inclination U of any mirror facet can be computed for any distance from a fixed focal axis whose focal point is F units above the array plane. The angle will hold true for axial distributions of arrays, lines that all originate from the focal axis.

Always work and act in a safe manner