2.22 Arbitrary Orientation and Tilt

任意的朝向和倾角的组件接收的光强

For a module at an arbitrary tilt and orientation the equation becomes a little more complicated:

$$S_{module} = S_{incident}[\cos\alpha \sin\beta \cos(\Psi - \Theta) + \sin\alpha \cos\beta]$$

α is the sun elevation angle and Θ is the sun azimuth angle. β is the module tilt angle. A module lying flat on the ground has $\beta = 0°$ and a vertical module has a $\beta = 90°$. Ψ is the azimuth angle that the module faces. The vast majority of modules are aligned to face towards the equator. A module in the southern hemisphere will be facing north with $\Psi = 0°$ and a module in the northern hemisphere will typically face directly south with $\Psi = 180°$. S_{module} and $S_{incident}$ are respectively the light intensities on the module and of the incoming light in W/m^2, the $S_{incident}$ being a direct only component.

对于以任意朝向和倾角摆放的组件来说，入射功率和组件功率的公式会稍微复杂一些：

$$S_{module} = S_{incident}[\cos\alpha \sin\beta \cos(\Psi - \Theta) + \sin\alpha \cos\beta]$$

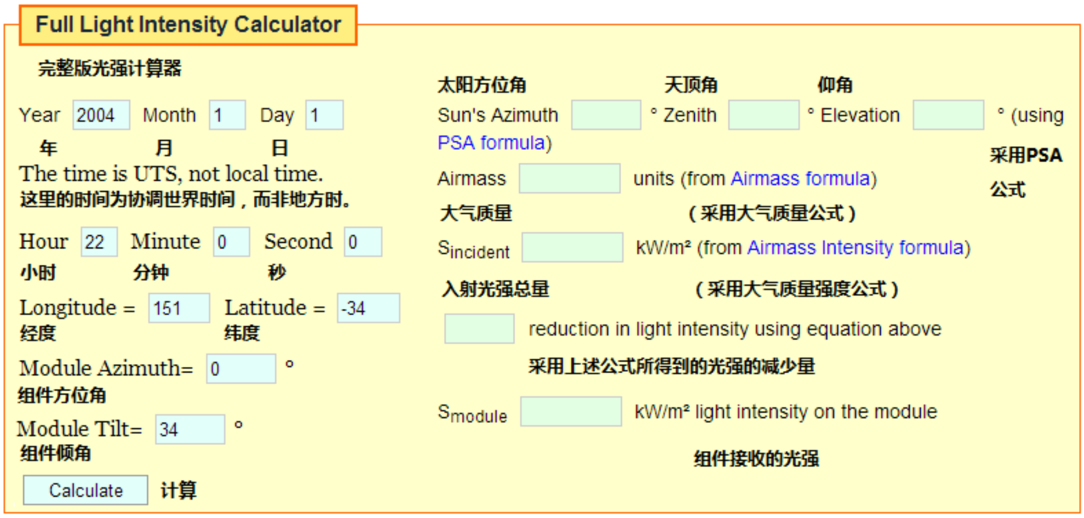
α表示太阳仰角，Θ表示太阳方位角。β为组件倾角，水平和竖直放置的组件的倾角分别为 0 度和 90 度。Ψ表示组件朝向方位角。大部分的组件都是面向赤道摆放的。南半球的组件朝北摆放，因此$\Psi = 0°$。北半球的组件朝南摆放，因此$\Psi = 180°$。S_{module}和 $S_{incident}$分别为入射太阳光的光强和组件接收的光强，单位为瓦每平方米，此处的入射太阳光强只考虑直射分量。

A module that directly faces the sun so that the incoming rays are perpendicular to the module surface has the module tilt equal to the sun's zenith angle ($90 - \alpha = \beta$), and the module azimuth angle equal to the sun's azimuth angle ($\Psi = \Theta$).

垂直于阳光入射方向放置的组件的倾角等于太阳的天顶角（$90 - \alpha = \beta$）。组件的方位角等于太阳的方位角（$\Psi = \Theta$）。

The following calculations combine the calculation of sun's position with the Airmass formula and then calculates the intensity of light incident on a module with arbitrary tilt and orientation.

在计算太阳位置时，下文在考虑了大气质量公式的前提下计算出任意倾角和朝向的组件接收到的光强。

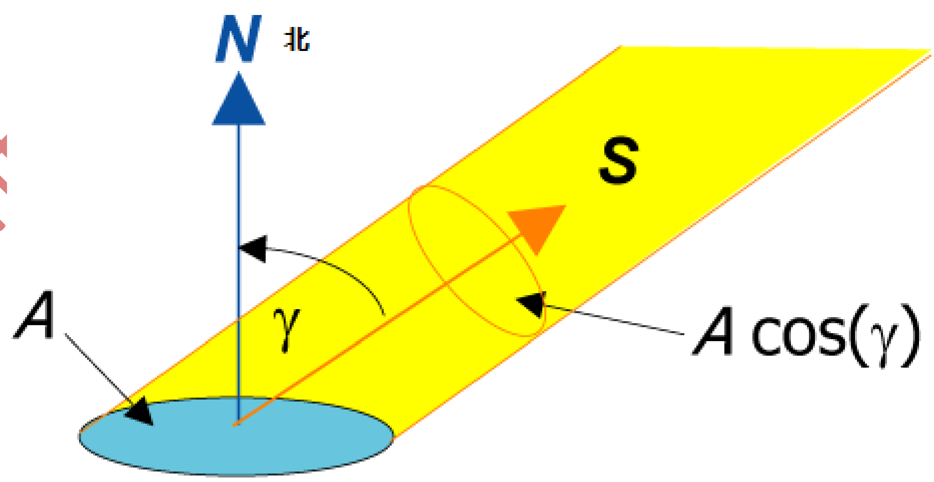


Using Vectors to Calculate Solar Direction

采用向量法计算太阳位置

As the number of tilts and orientations become more complicated it is often easier to convert the solar directions of azimuth and elevation to vectors. An example is where there is a tilted module on a building that is also at an arbitrary tilt and orientation. The simplicity of using vector comes from the fact that the reduction in intensity of light on a tilted surface is simply the dot product between the incident ray and the normal to the module.

由于组件倾角和朝向变得更复杂了，将太阳的方位角和仰角转化为向量可以简化计算。下面的例子是一个建筑物上倾斜放置的组件，它的倾角和朝向都是任意的。运用向量法的简便性在于斜面接收的阳光强度占入射光强的比例即为入射光方向与组件法线方向单位向量的点积。



Light striking a surface at an angle is spread out over a larger area. The reduction in intensity is the dot product of the unit vectors **S** and **N**.

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斜入射到组件表面的光会扩大到一个更大的面积。组件接收的光强占入射光强的比例为单位向量 **S** 和 **N** 的点积。

$$S_{module} = S_{incident} \cos \gamma = S_{incident} \boldsymbol{S} \cdot \boldsymbol{N}$$

where S_{module} and $S_{incident}$ are as defined before and **S** is the unit vector point towards the sun and **N** is the unit vector normal to the surface of the module. γ is the angle between the two vectors.

公式中的S_{module}和$S_{incident}$的定义在之前已经给出。**S** 是指向阳光方向的单位向量，**N** 为组件表面法线方向的单位向量，γ为两向量之间的夹角。

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