Supplementary document

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0.1 Derivation of the Design parameters of $l2$

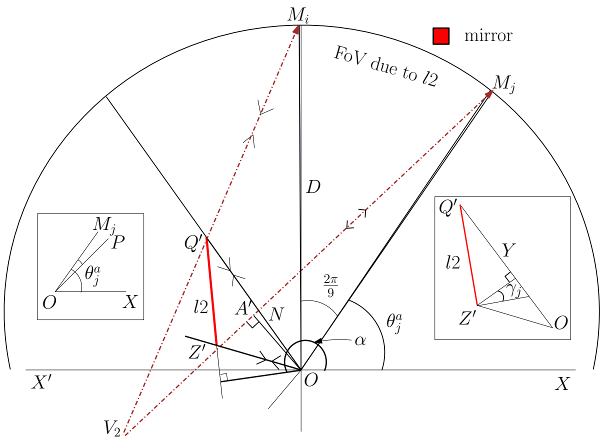

Figure 1: Geometry of the mirror configuration not to scale; for $l2$. Zoomed-in views of the portions near the center O are provided for the betterment of understanding the geometry.

In $\triangle Z'OM_j$, $\angle OM_jZ' = \sin^{-1}(\frac{OA}{OM_j})$. Therefore, $\angle OZ'M_j = \pi - (\angle M_jOZ' + \angle OM_jZ')$. Also, $OA = OZ' \sin(\angle OZ'M_j)$. Again, for the j-th incident beam the angle of incidence $\gamma_j = \angle OZ'M_j/2$. To calculate α, we use the I-th beam. Then, $\alpha = \theta_j + \gamma_j$. Also, $\angle OQ'Z' = \frac{\pi}{2} - \gamma_j - \angle Q'OZ'$. Now, based on the LIDAR's scan direction, the first beam to hit on $l2$ is OQ' and due to the known bearings of the transmitted laser pulses, we can calculate $\angle Q'OZ' = (\angle X'OZ' - \angle X'OQ')$. At this point, a perpendicular YZ' is drawn on OQ' from Z'. Then, from $\triangle OYZ'$, $YZ' = OZ' \sin(\angle YOZ')$, $OY = \frac{YZ'}{\tan(\angle YOZ')}$, and $YQ' = \frac{YZ'}{\tan(\angle OQ'Z')}$. Therefore, $L = |Q'Z'| = \frac{YZ'}{\sin(\angle YQ'Z')}$.