The complex two dimensional field on the sensor is given by $\mathbf{E}(\mathbf{r}) = \mathbf{E}(x, y)$. There are six fundamental parameters describing a vortex, which in turn completely define the underlying field. In two dimensions, these are $\mathbf{r}$ and the partial derivative $\nabla\mathbf{E}(\mathbf{r})$. These in turn can be transformed into six "morphological parameters": topological charge q, rotation ρ, skewness σ, amplitude a, and ansitropy α.

$$\rho = \arctan\left(\frac{\mathrm{Re}(\nabla\mathbf{E})_y}{\mathrm{Re}(\nabla\mathbf{E})_x}\right) \qquad \text{(rotation)} \qquad (1)$$

$$\sigma = -\arctan\left(\frac{\mathrm{Im}(\nabla\mathbf{E})_x}{\mathrm{Im}(\nabla\mathbf{E})_y}\right) - \rho \qquad \text{(skewness)} \qquad (2)$$

$$a = \frac{\mathrm{Re}(\nabla\mathbf{E})_x}{\cos\rho} = \frac{\mathrm{Re}(\nabla\mathbf{E})_y}{\sin\rho} \qquad \text{(amplitude)} \qquad (3)$$

$$\alpha = \frac{-\mathrm{Im}(\nabla\mathbf{E})_x}{\big(\alpha\sin(\rho+\sigma)\big)} = \frac{-\mathrm{Im}(\nabla\mathbf{E})_y}{\big(\alpha\cos(\rho+\sigma)\big)} \qquad \text{(anisotropy)} \qquad (4)$$

$$q = \mathrm{sgn}\left(\left|\begin{pmatrix}\mathrm{Re}(\nabla\mathbf{E})_x & \mathrm{Re}(\nabla\mathbf{E})_y \\ \mathrm{Im}(\nabla\mathbf{E})_x & \mathrm{Im}(\nabla\mathbf{E})_y\end{pmatrix}\right|\right) \qquad \text{(charge)} \qquad (5)$$

$$\mathbf{E}(x, y) = a\Big(x\cos\rho + y\sin\rho + \mathrm{i}\alpha\big(y\cos(\rho+\sigma) + x\sin(\rho+\sigma)\big)\Big) \qquad (6)$$