Perp-Dot Product Study

A proof in comparison with the z-component of the cross product

Relative to the GitHub account MageMCU to the repository DDMR-Orientation.

- Random angle (0-360) degrees used to instantiate a 2D vector called set point **p**.
- Compass heading (0-360) degrees used to instantiate a 2D vector called measured value **m**.

The Perp Operator ⊥ explanation: if we have a vector $\mathbf{v}$, then $\mathbf{v}^{\perp}$ is a vector perpendicular to $\mathbf{v}$.[1]

$$\mathbf{m}^{\perp} = [\mathrm{m_x}, \mathrm{m_y}] \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} = [-\mathrm{m_y}, \mathrm{m_x}]$$

The Perp-Dot Operation

$$\mathbf{m}^{\perp} \cdot \mathbf{p} = -\,\mathrm{m}_{\mathbf{y}}\mathrm{p_x} + \mathrm{m}_{\mathbf{x}}\mathrm{p_y} = \mathrm{m}_{\mathbf{x}}\mathrm{p_y} + (-\mathrm{m}_{\mathbf{y}}\mathrm{p_x}) = \mathrm{m}_{\mathbf{x}}\mathrm{p_y} - \mathrm{m}_{\mathbf{y}}\mathrm{p_x}$$

The Cross Product:

$$\mathbf{m} \times \mathbf{p} = (\mathrm{m_y p_z} - \mathrm{m_z p_y}, \quad \mathrm{m_z p_x} - \mathrm{m_x p_z}, \quad \mathrm{m_x p_y} - \mathrm{m_y p_x})$$

If the operations are planer in the x and y axis, then the Perp-Dot Operation is equal to the z-component of the Cross Product where $\mathbf{m}$ and $\mathbf{m}^{\perp}$ are perpendicular.

Carpenter Software
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1. Philip J. Schneider, David H. Eberly, *Geometric Tools for Computer Graphics* (2002) 123.