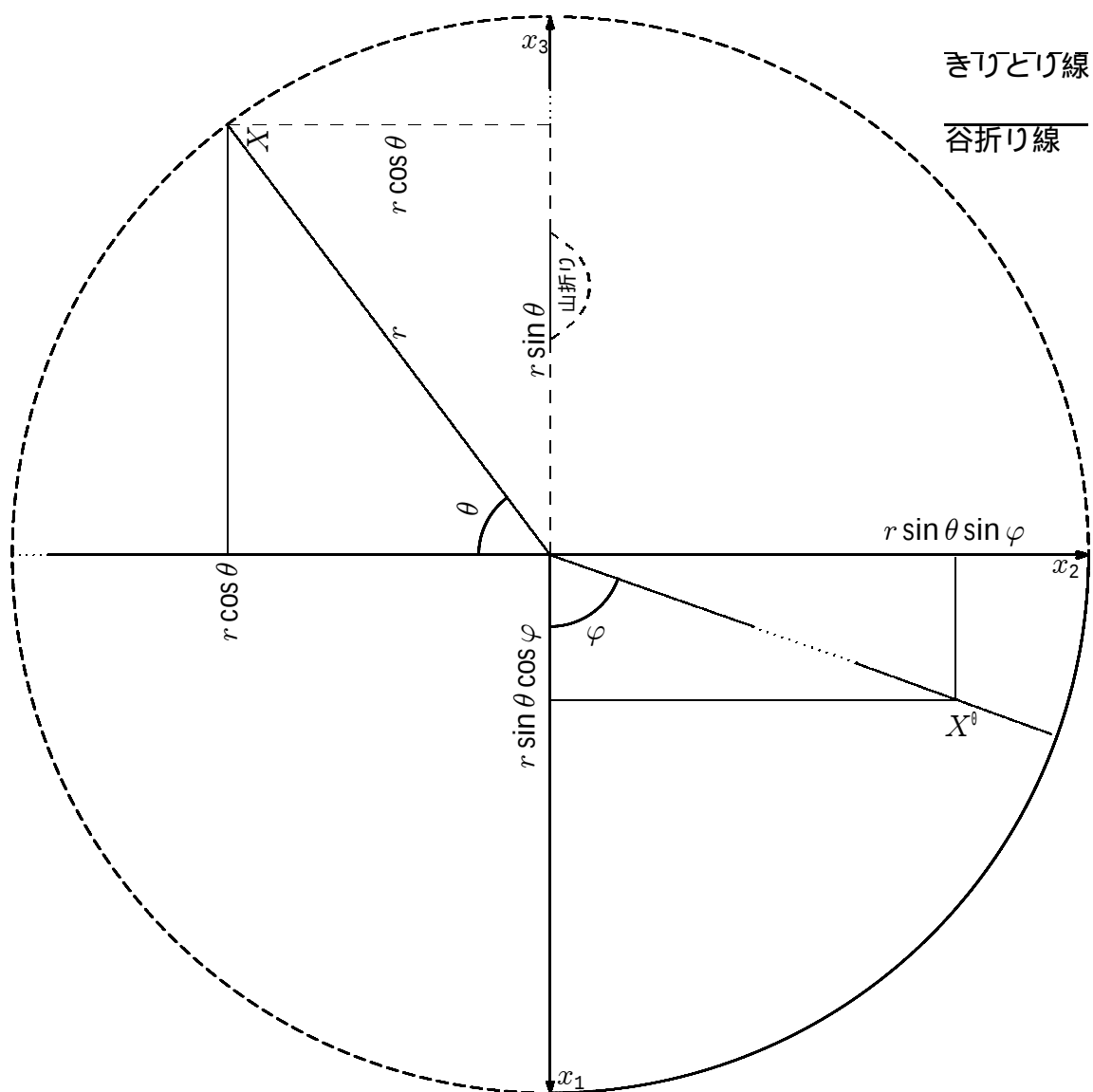




極座標変換 $(x_1, x_2, x_3) = (r \sin \theta \cos \varphi, r \sin \theta \sin \varphi, r \cos \theta)$ の Jacobi 行列と Jacobian は

$$\begin{pmatrix} \sin \theta \cos \varphi & r \cos \theta \cos \varphi & -r \sin \theta \sin \varphi \\ \sin \theta \sin \varphi & r \cos \theta \sin \varphi & r \sin \theta \cos \varphi \\ \cos \theta & -r \sin \theta & 0 \end{pmatrix}, \quad r^2 \sin \theta.$$