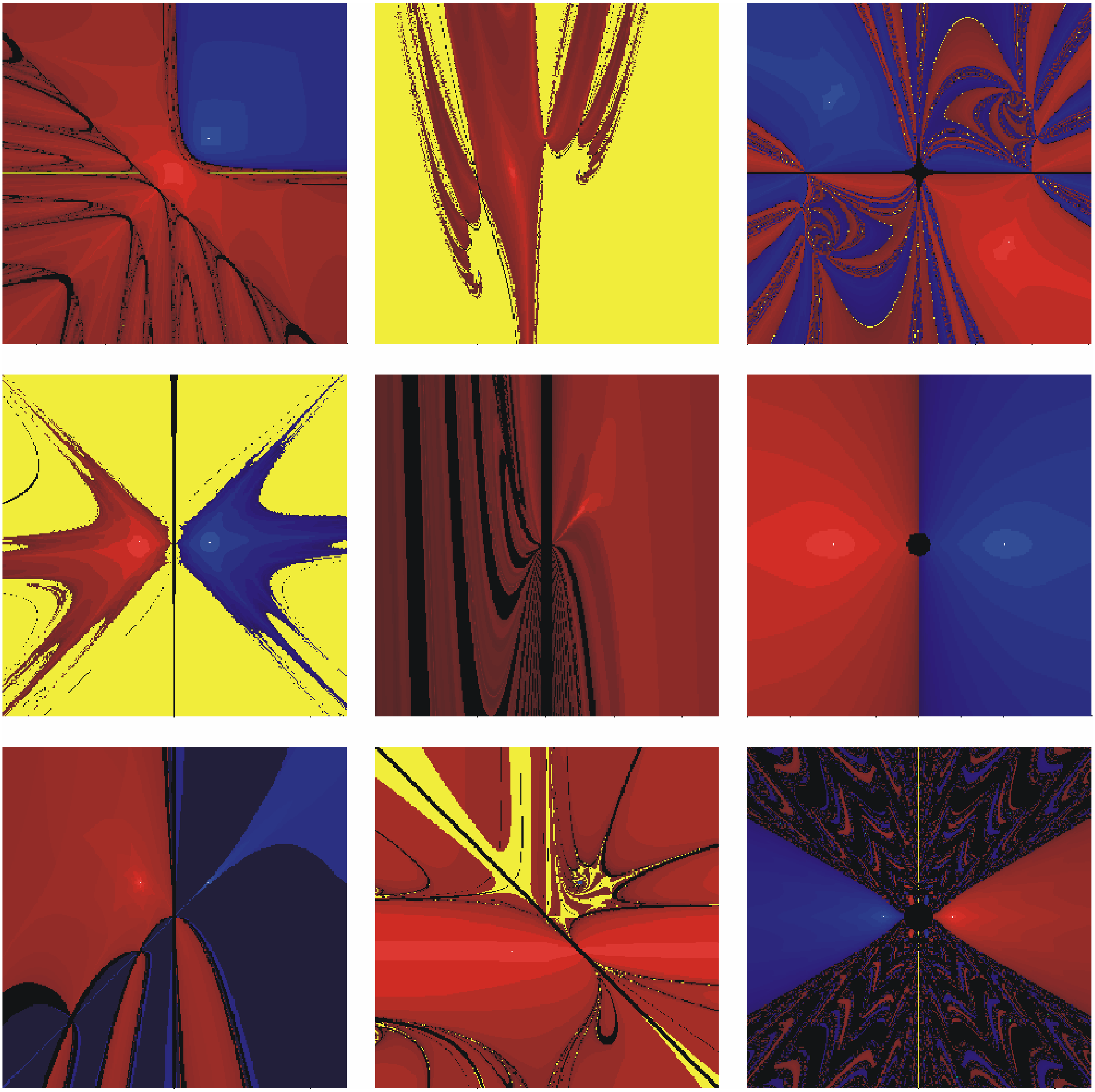
Newton Method Convergence Maps



These images illustrate the roots that an initial guess converges to with the Newton Method for functions from $\mathbb{R}^2 \to \mathbb{R}^2$. The red area converges to one root while the blue area converges to another. Furthermore, a lighter shade indicates a faster convergence. Yellow area represents starting values that diverge to infinity and black area indicates that the Jacobian became singular during iteration. All of the displayed domains are $[-5,5]\times[-5,5] \in \mathbb{R}^2$. except the top right image ($[-3,3]\times[-3,3]$) and the image under top right ($[-2,2]\times[-2,2]$) The functions from top left to bottom right are as follows with $u=\begin{bmatrix}x & y\end{bmatrix}^T \in \mathbb{R}^2$ and $z \in \mathbb{C}$. $F(u)=\begin{bmatrix}x^2-y & y^2-x\end{bmatrix}^T$

$F(u)=\begin{bmatrix}-x^2-y+1 & x^2-y+1\end{bmatrix}^T$ $F(u)=\begin{bmatrix}x^2-y^2-1 & x^2+y^2-4\end{bmatrix}^T$ $F(u)=\begin{bmatrix}x^2-y^2-1 & \frac{1}{16}x^2-y\end{bmatrix}^T$ $F(u)=\begin{bmatrix}x^3-y & y-1\end{bmatrix}^T$

$F(z)=z^2-1$ $F(u)=\begin{bmatrix}x^2-y & y-1\end{bmatrix}^T$ $F(u)=\begin{bmatrix}x-y & xy-1\end{bmatrix}^T$ $F(z)=z^4-1$