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Stationary Velocity Fields on Matrix Groups for Deformable Image Registration

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We present an extension of the Stationary Velocity Field (SVF) approach to matrix groups, with a particular focus on the Special Euclidean group SE(3). The SVF method is a popular tool for parameterizing invertible deformation fields and is particularly effective when integrated into machine learning-based networks. However, it can struggle with modeling large deformations. By extending the SVF approach to matrix groups like SE(3), we move Euclidean transformations into the low-frequency domain, aligning them with the natural bias of many neural network architectures towards low-frequency components. This extension can result in improved handling of large motions, allowing for more robust and efficient recovery in tasks that involve significant deformations. This method addresses challenges in deformation modeling, making it particularly relevant for deep learning-based applications.

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