Supplementary material and movies for Early evolution of optimal perturbations in a viscosity-stratified channel

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This supplementary information contains five movies which show the evolution of the optimal perturbations in figures 5, 6, 8, 13, and 14 in the main text. The three figures show the evolution of the streamwise vorticity of the optimal perturbations in figures 8, 13, and 14 in the main text.

Movie1: The time evolution of the linear unstratified optimal perturbation. Also refer to figure 5 in the main text.

Movie2: The time evolution of the linear viscosity-stratified optimal perturbation with $\Delta T = 40$ K. Also refer to figure 6 in the main text.

Movie3: The time evolution of the linear viscosity-stratified optimal perturbation ($\Delta T = 40$ K) when scaled to nonlinear initial energy $E_0 = 10^{-2}$. Also refer to figure 8 in the main text.

Movie4: The time evolution of the nonlinear unstratified optimal perturbation. Also refer to figure 13 in the main text.

Movie5: The time evolution of the nonlinear viscosity-stratified optimal perturbation with $\Delta T = 40$ K. Also refer to figure 14 in the main text.

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a) t = 0

$Ly = 2$

b) t = 2

c) t = 4

$Ly = 2$

d) t = 6

$Lx = 2\pi$

$Lz = \pi$
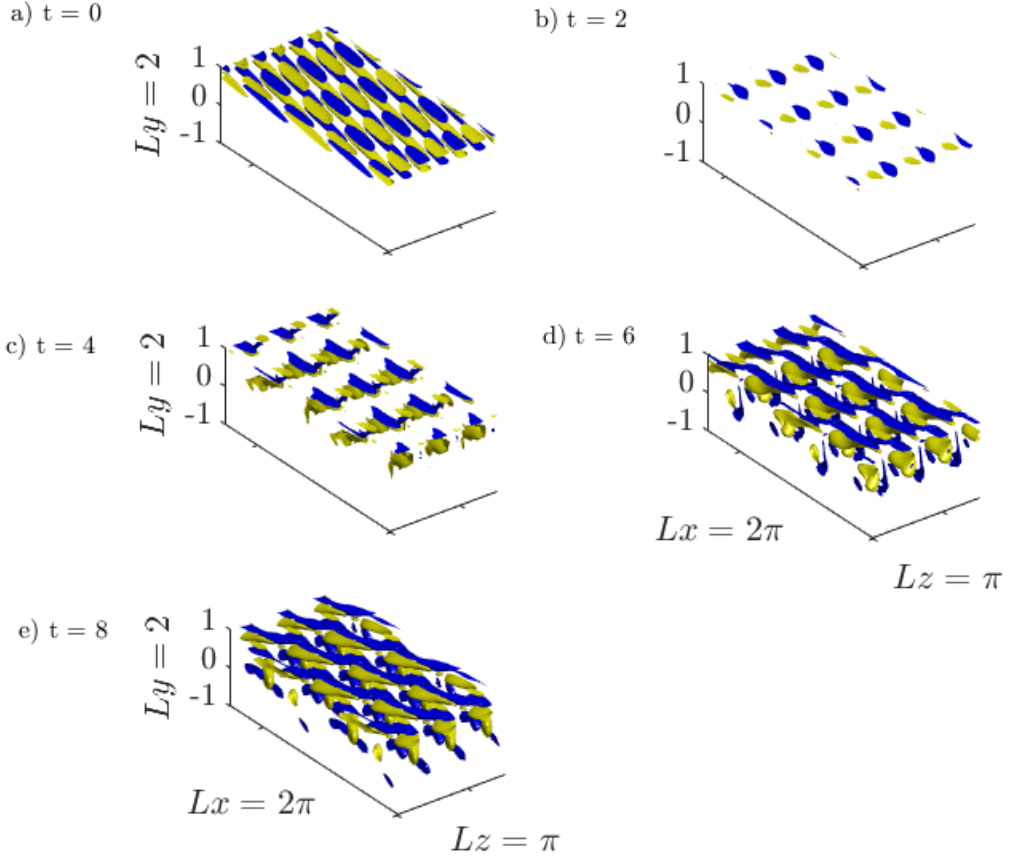
e) t = 8

$Ly = 2$

$Lx = 2\pi$

$Lz = \pi$

FIGURE 1. Evolution of the streamwise vorticity of the linear viscosity-stratified optimal perturbation ($\Delta T = 40$ K) scaled to nonlinear initial energy $E_0 = 10^{-2}$. The 40% isosurfaces of the maximum (yellow) and the minimum (blue) of the streamwise vorticity are shown at corresponding times. The evolution of corresponding streamwise perturbation velocity is shown in figure 8 in the main text.
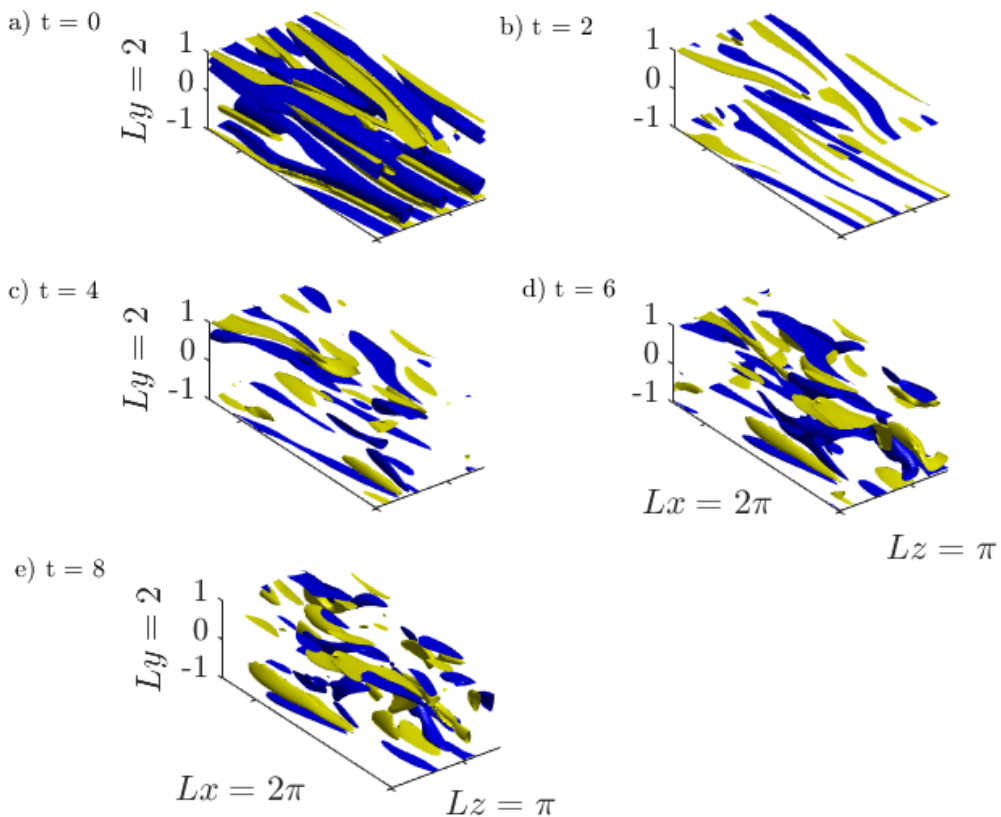
FIGURE 2. Evolution of the streamwise vorticity of the nonlinear unstratified optimal perturbation with $E_0 = 10^{-2}$. The 40% isosurfaces of the maximum (yellow) and the minimum (blue) of the streamwise vorticity are shown at corresponding times. The evolution of corresponding streamwise perturbation velocity is shown in figure 13 in the main text.
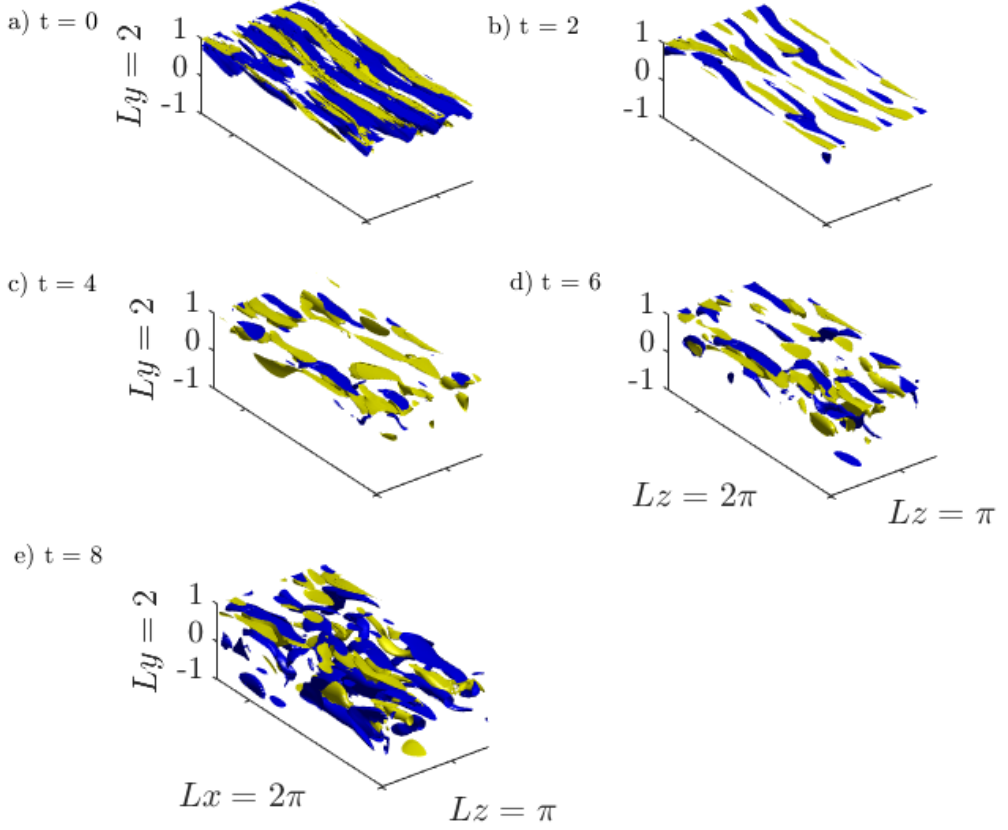
FIGURE 3. Evolution of the streamwise vorticity of the nonlinear viscosity-stratified optimal perturbation ($\Delta T = 40$ K) with $E_0 = 10^{-2}$. The 30% isosurfaces of the maximum (yellow) and the minimum (blue) of the streamwise vorticity are shown at corresponding times. The evolution of corresponding streamwise perturbation velocity is shown in figure 14 in the main text.