# Global Exercise - Gue09

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Content covered:

- ✓ Programming exercise 02: Explanation + Hints.
- ✓ Analysis:
  - * Expansion of $f(x, y)$ in eigenfunctions of Laplace operator (2D).
  - * Distributional derivative.
- ✓ Numerics: Ghost points in FDM + Neumann BCs.

## 1 Programming exercise 02: Explanation + Hints

**Example 1.** *Examine the following*

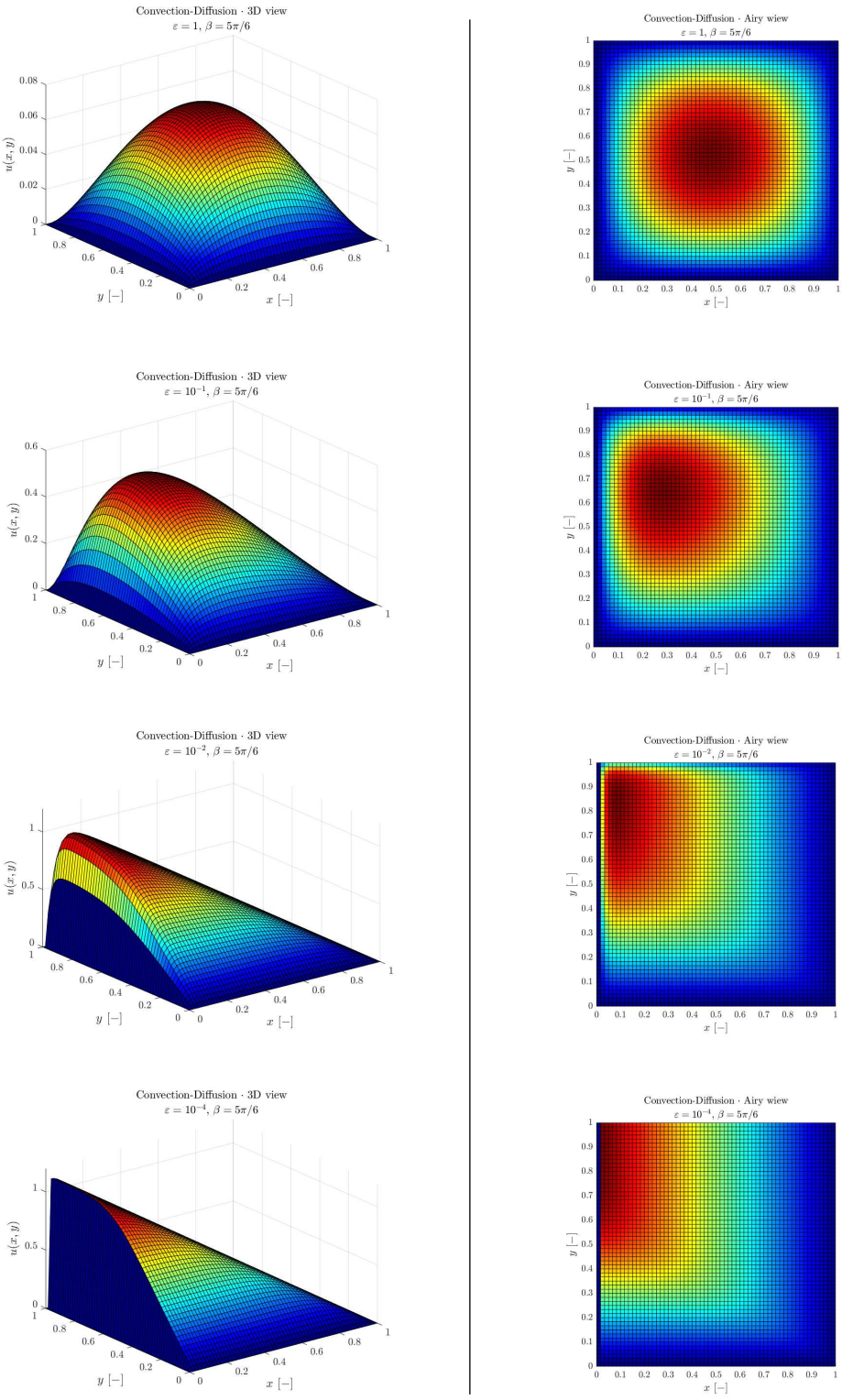



Figure 1: Comparison among different values of $\varepsilon = [1, 10^{-1}, 10^{-2}, 10^{-4}]$: Upwind differences used for discretizing convection terms $\partial_x u$ and $\partial_y u$; fixed $\beta = 5\pi/6$.

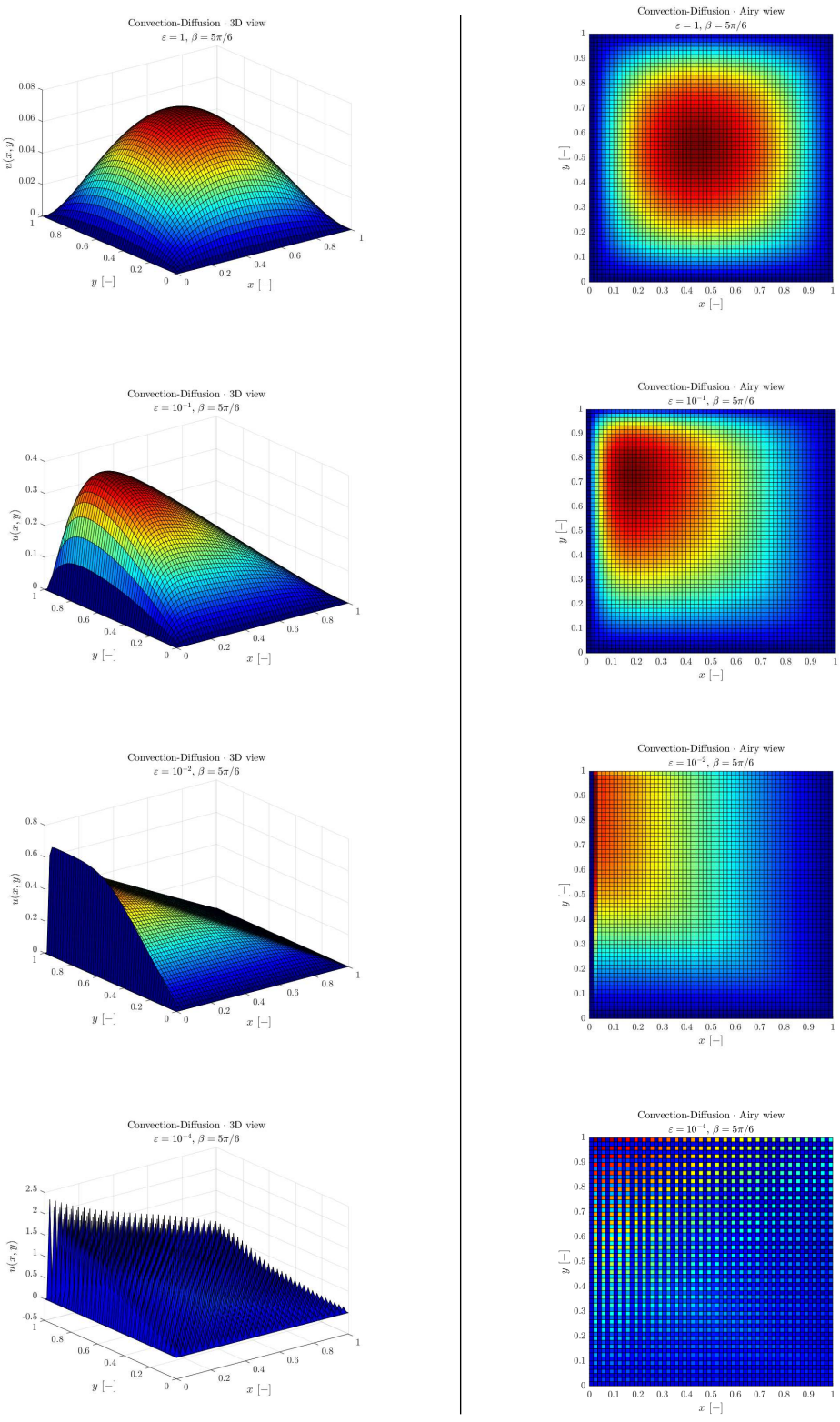
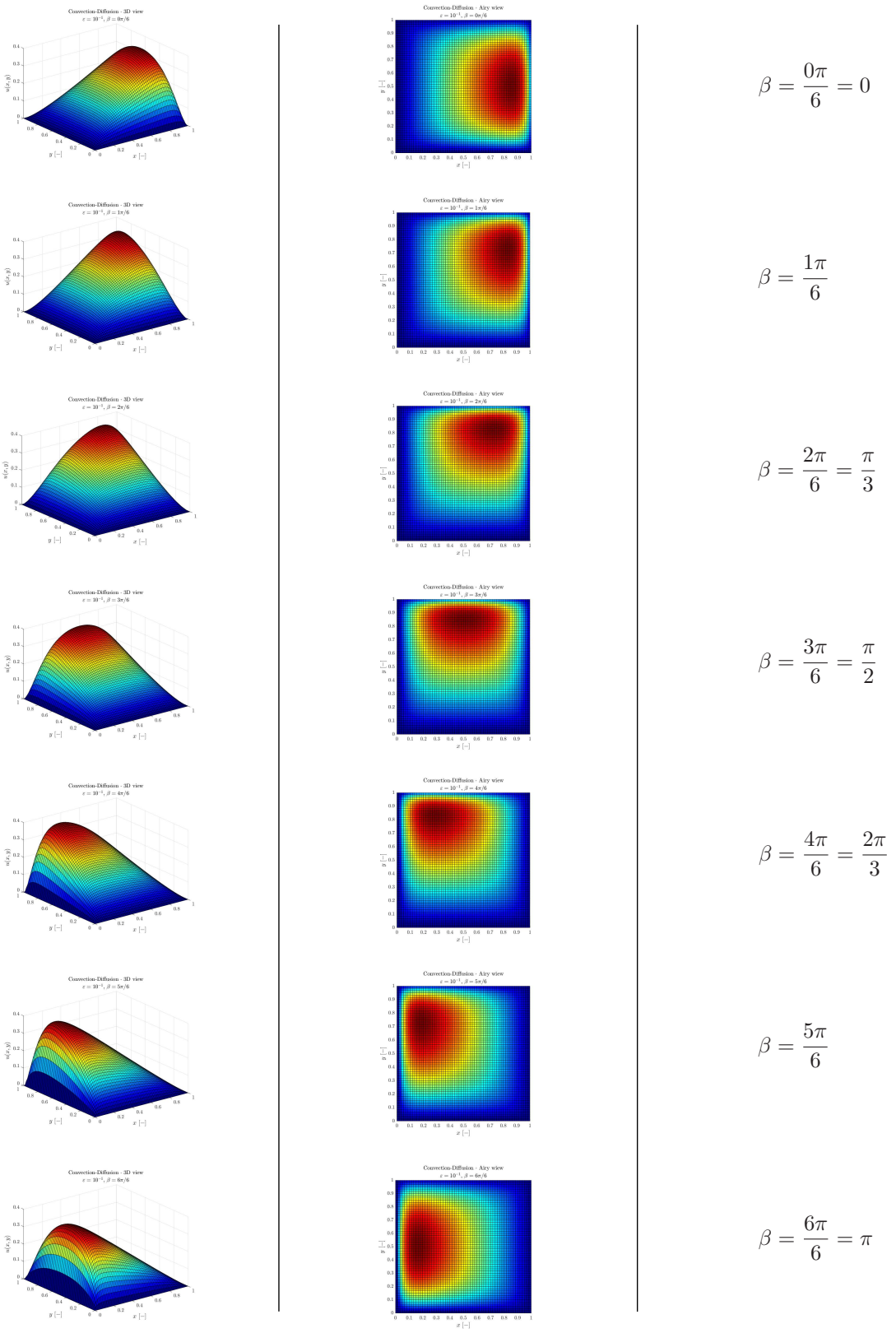



Figure 2: Comparison among different values of $\varepsilon = [1, 10^{-1}, 10^{-2}, 10^{-4}]$: Central difference used for discretizing convection terms $\partial_x u$ and $\partial_y u$; fixed $\beta = 5\pi/6$.



$\beta = \frac{0\pi}{6} = 0$

$\beta = \frac{1\pi}{6}$

$\beta = \frac{2\pi}{6} = \frac{\pi}{3}$

$\beta = \frac{3\pi}{6} = \frac{\pi}{2}$

$\beta = \frac{4\pi}{6} = \frac{2\pi}{3}$

$\beta = \frac{5\pi}{6}$

$\beta = \frac{6\pi}{6} = \pi$

Figure 3: Comparison among different values of $\beta = \left[0, \frac{\pi}{6}, \frac{2\pi}{6}, \frac{3\pi}{6}, \frac{4\pi}{6}, \frac{5\pi}{6}, \pi\right]$: Upwind differences used for discretizing convection terms $\partial_x u$ and $\partial_y u$; fixed $\varepsilon = 10^{-1}$.

## 2 Analysis: 2D Eigenfuctions of Laplace operator

**Example 2.** *Examine the following*

# 3 Analysis: Distribution and its derivative

**Example 3.** *Examine the following*

# 4 Numerics: Ghost points in FDM

**Example 4.** *Examine the following*

# 5 Evaluation

Figure 4: QR Code for evaluation of Global exercises.

Alternative link: here