Chapter 1

Test Functions

- Test Function 01 - Linear function

$$f(x, y, z) = 2x + 2y + 2z$$

- Test Function 02 - Quadratic function

$$f(x, y, z) = x^2 + y^2 + z^2$$

- Test Function 03 - Quadratic function + constant

$$f(x, y, z) = x^2 + y^2 + z^2 + 1$$

- Test Function 04 - Quadratic function with mixed terms

$$f(x, y, z) = 3xy + 3yz + 3xz$$

- Test Function 05 - Sinusoidal functions - linear combination

$$f(x, y, z) = 6 \sin x + 6 \sin y + 6 \sin z$$

- Test Function 06 - Sinusoidal functions - linear combination + constant

$$f(x, y, z) = 6 \sin x + 6 \sin y + 6 \sin z + 1.$$

- Test Function 07 - Sinusoidal functions - quadratic combination

$$f(x, y, z) = 2 \sin x \sin y + 2 \sin x \sin z + 2 \sin y \sin z$$

- Test Function 08 - Exponential functions

$$f(x, y, z) = e^x e^y e^z + 2e^x e^y + 2e^x e^z + 2e^y e^z$$

1.1 Convergence Tests

$$e_{relative} = \frac{\|f_{analytical} - f_{numerical}\|}{\|f_{analytical}\| + Tol}$$

1.1.1 Linear Interpolant Operator - C2F

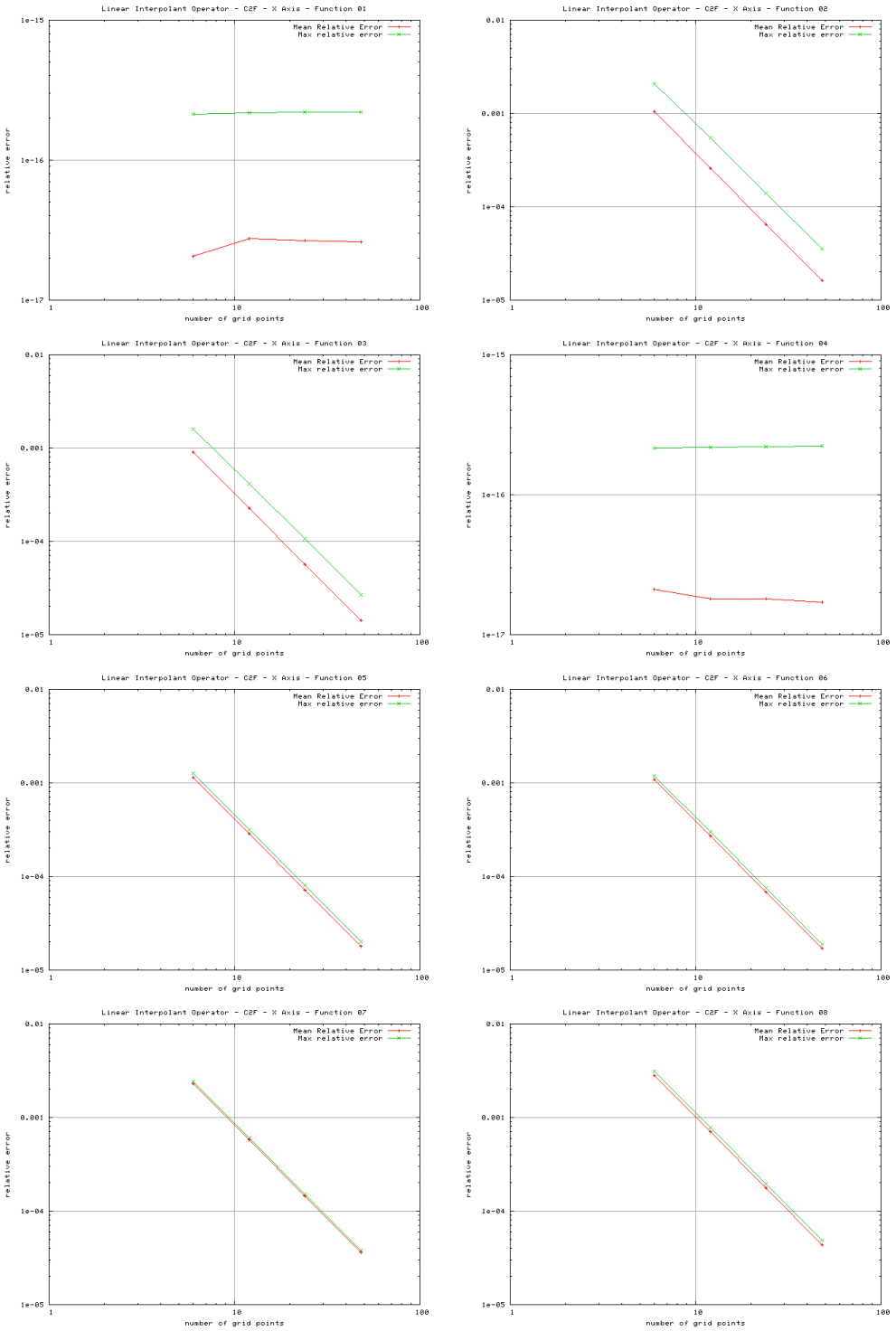

Figure 1.1: Linear Interpolant Operator - C2F - X Axis - Convergence Tests

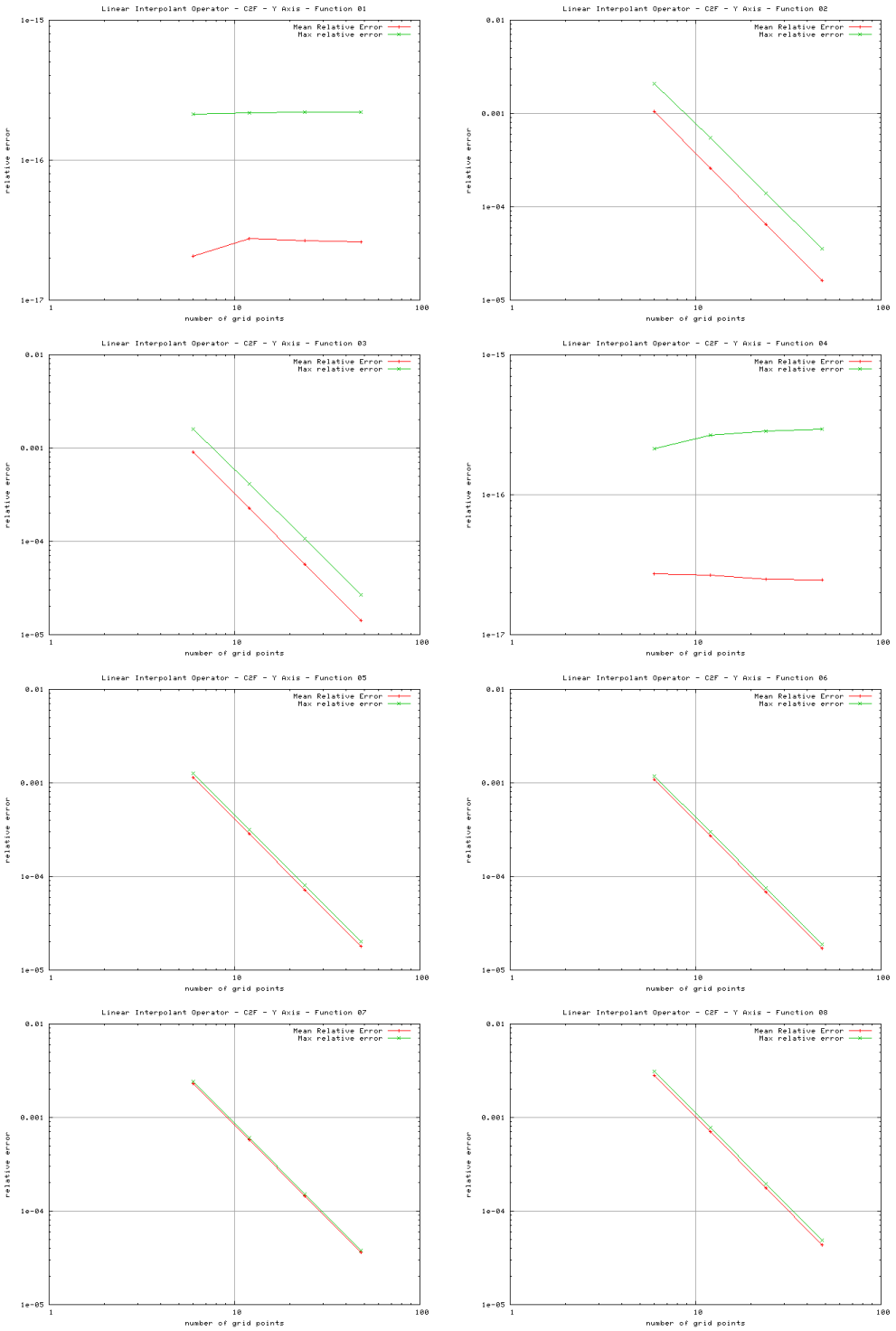

Figure 1.2: Linear Interpolant Operator - C2F - Y Axis - Convergence Tests

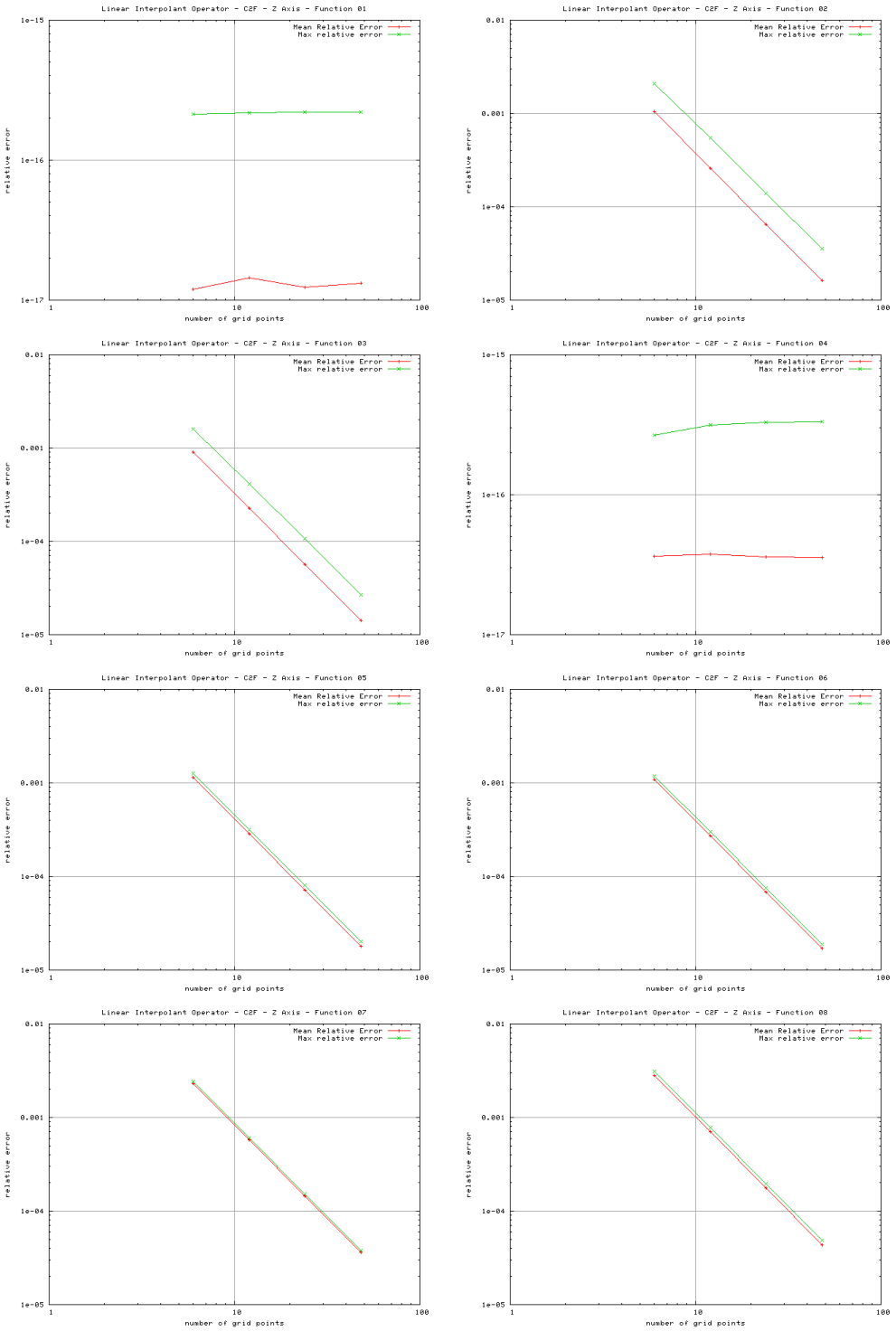

Figure 1.3: Linear Interpolant Operator - C2F - Z Axis - Convergence Tests

1.1.2 Linear Interpolant Operator - F2C

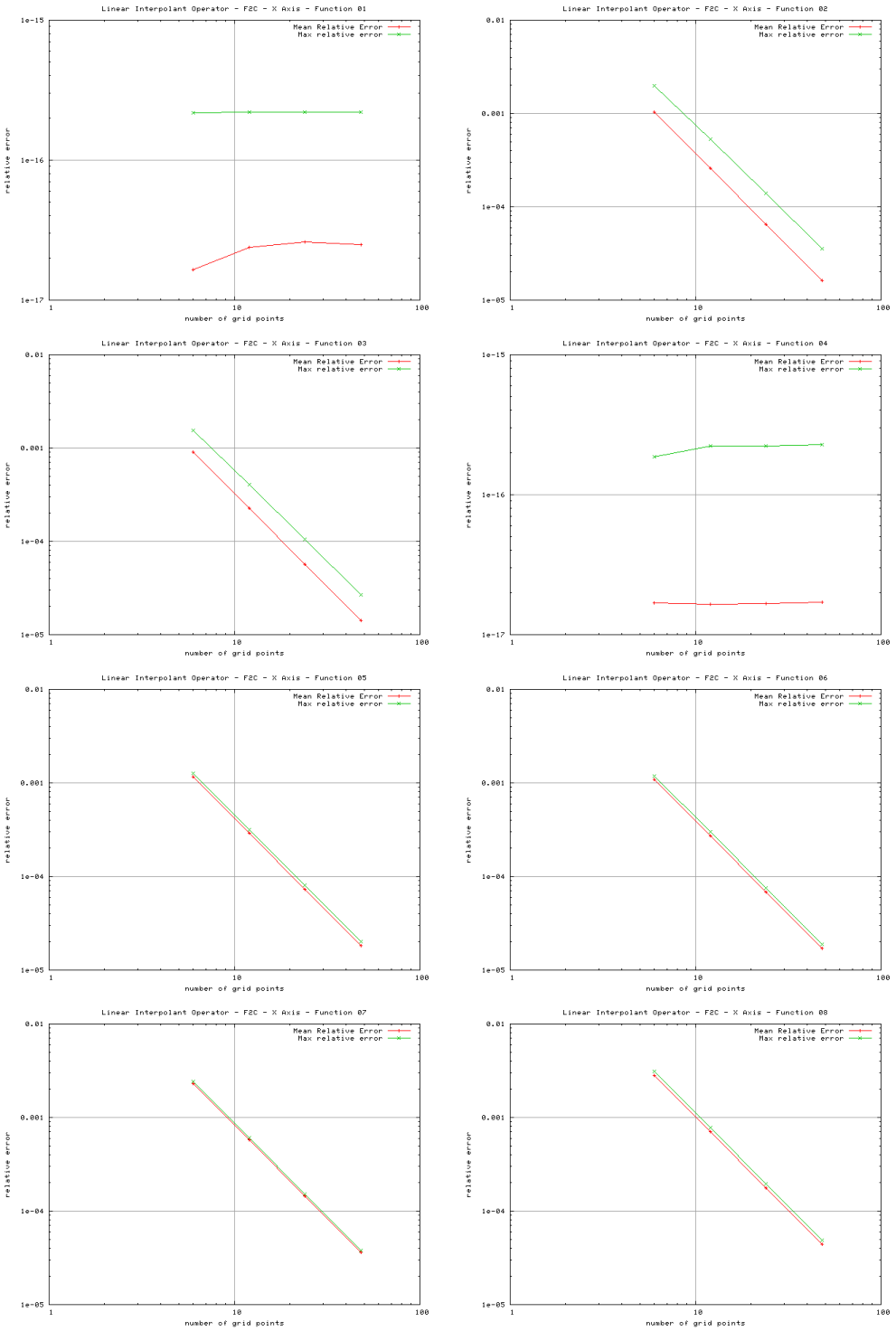

Figure 1.4: Linear Interpolant Operator - F2C - X Axis - Convergence Tests

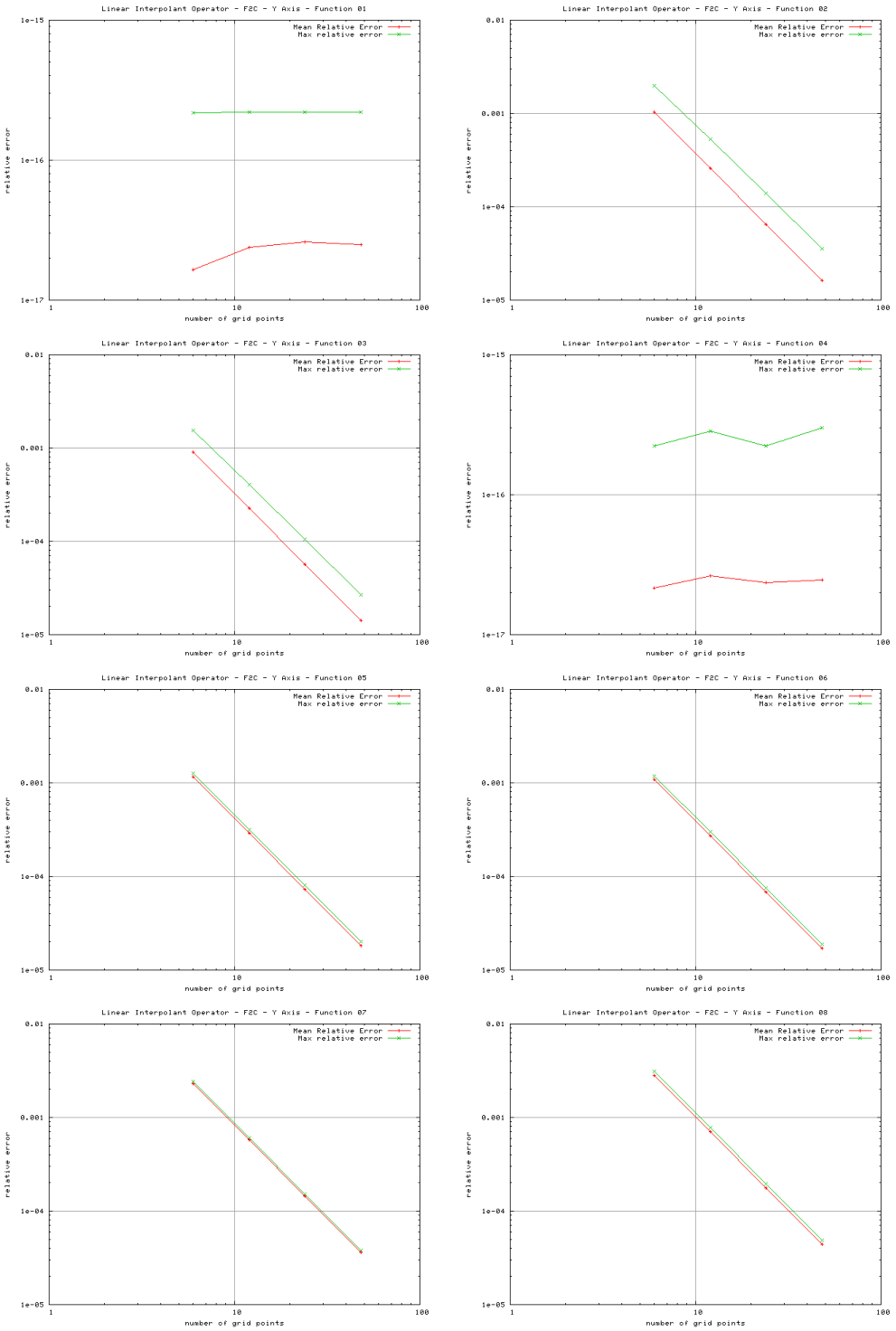

Figure 1.5: Linear Interpolant Operator - F2C - Y Axis - Convergence Tests

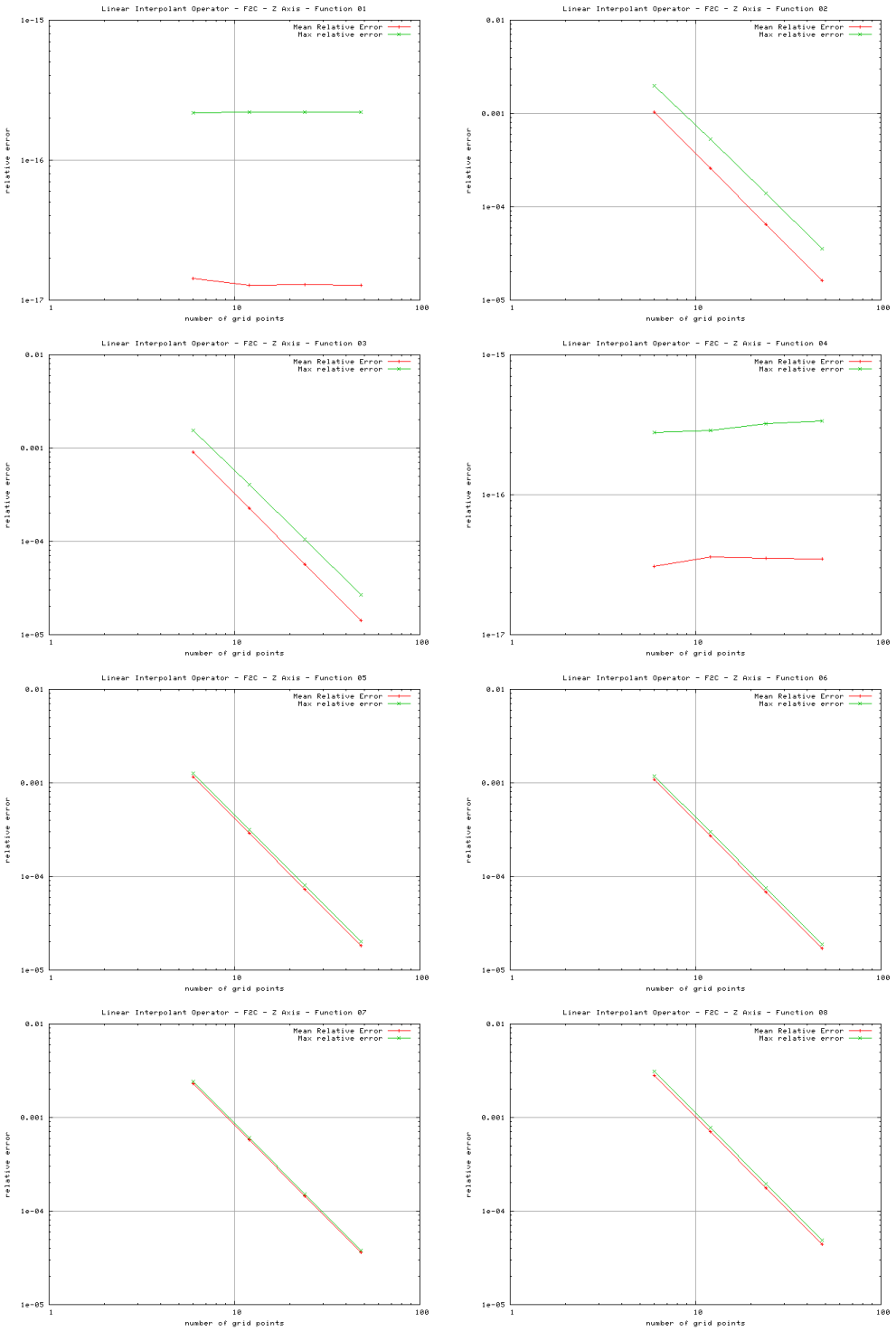

Figure 1.6: Linear Interpolant Operator - F2C - Y Axis - Convergence Tests

1.1.3 Gradient (2nd Order) Operator - C2F

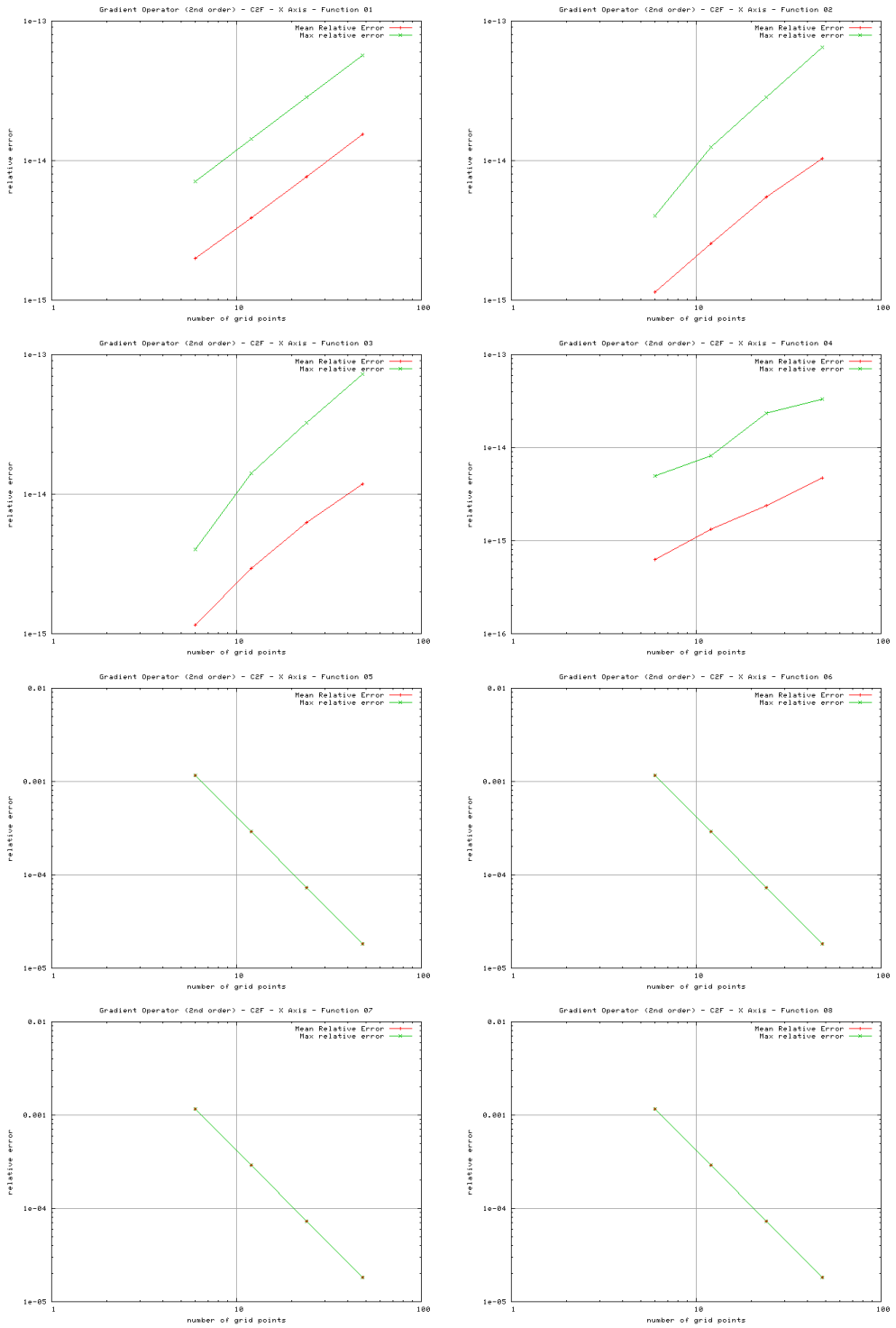

Figure 1.7: Gradient Operator (2nd order) - C2F - X Axis - Convergence Tests

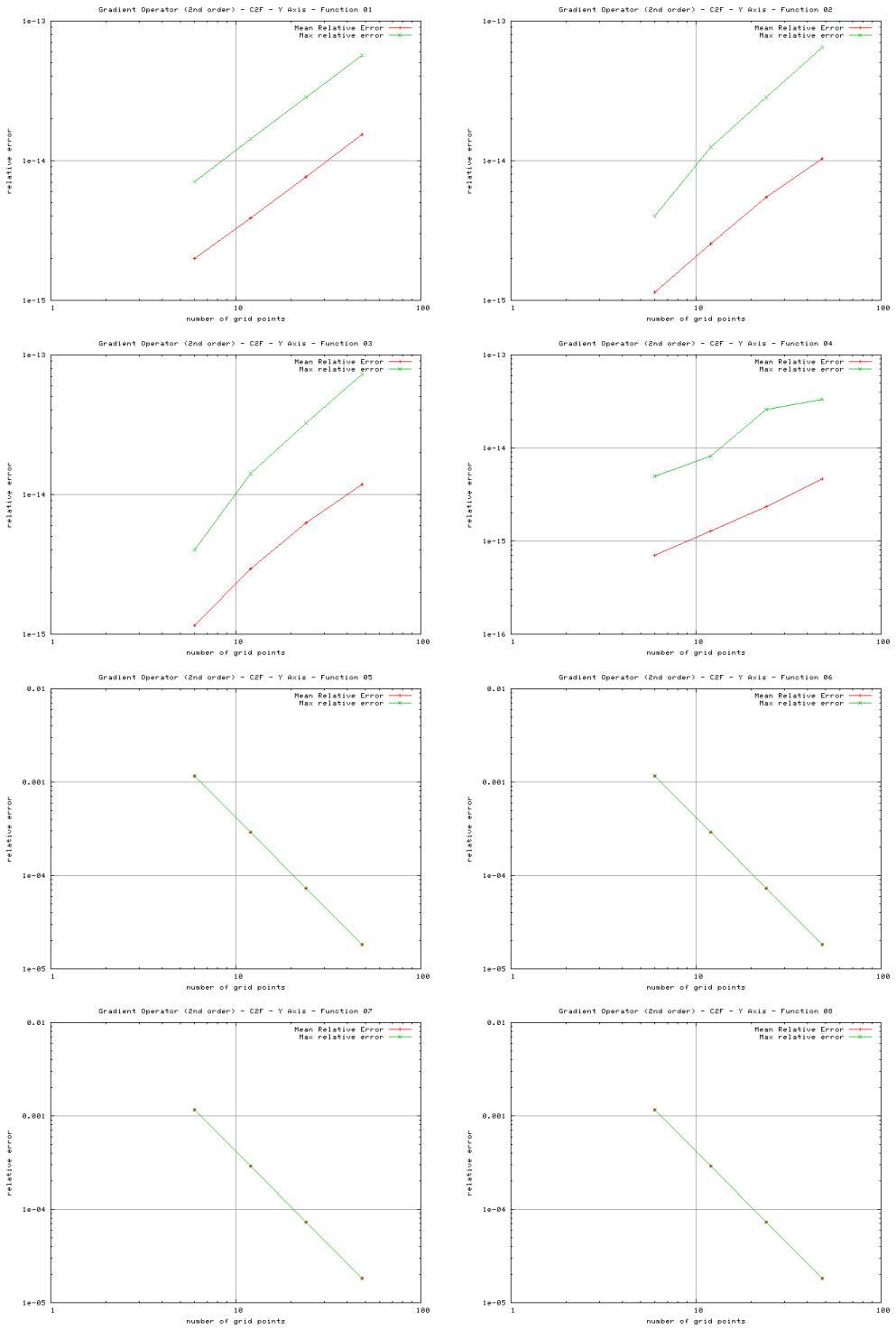

Figure 1.8: Gradient Operator (2nd order) - C2F - Y Axis - Convergence Tests

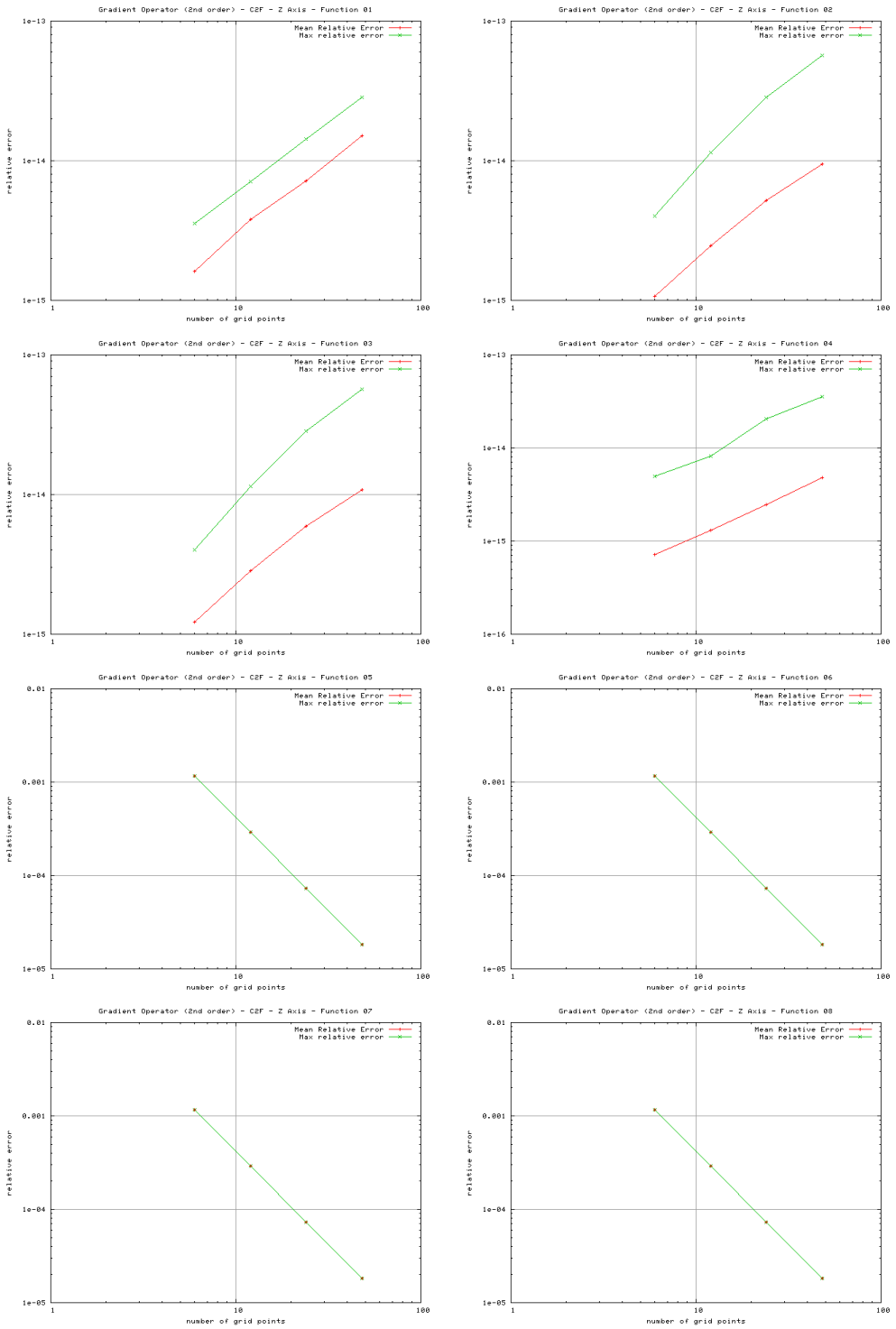

Figure 1.9: Gradient Operator (2nd order) - C2F - Z Axis - Convergence Tests

1.1.4 Gradient (2nd Order) Operator - F2C

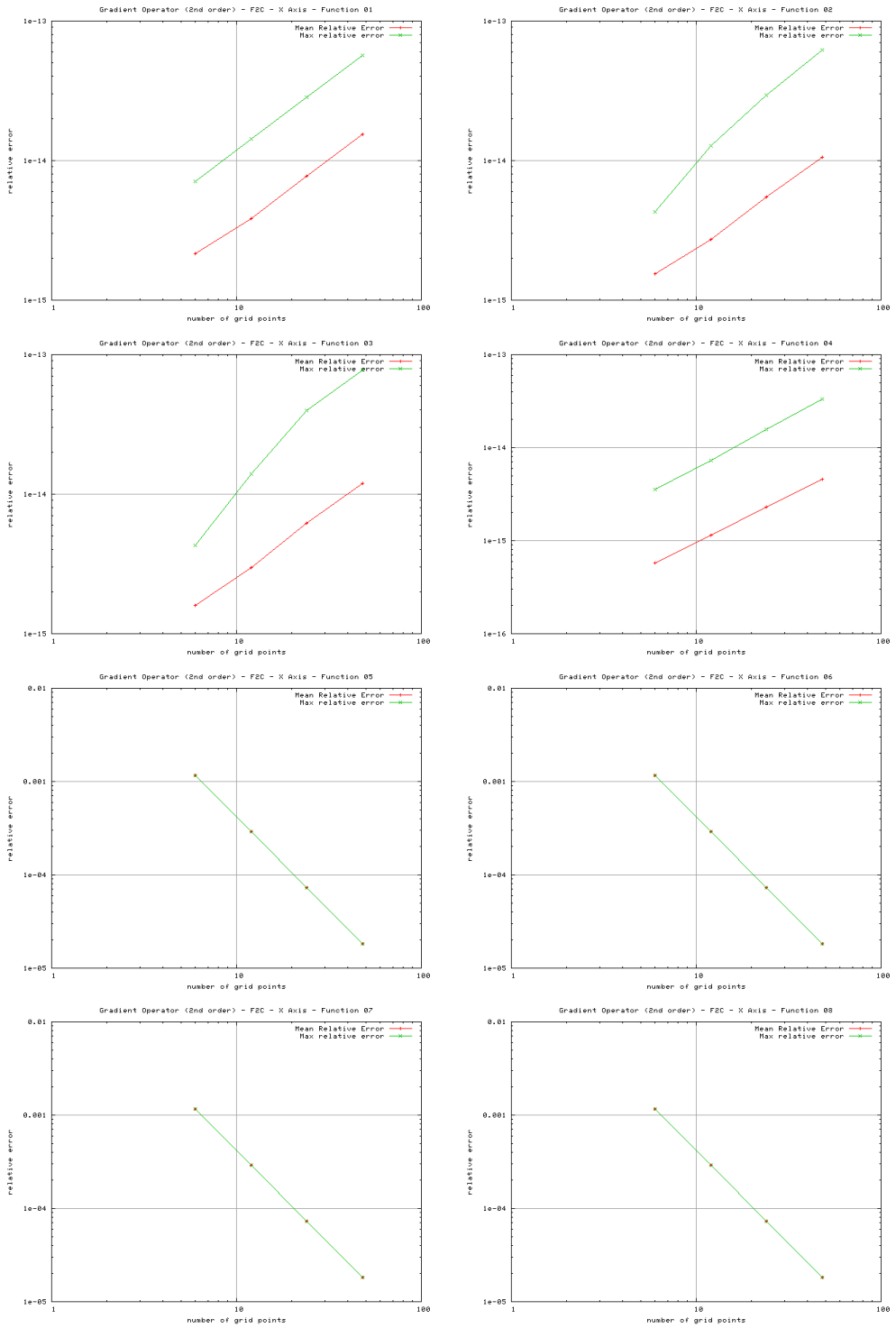

Figure 1.10: Gradient Operator (2nd order) - F2C - X Axis - Convergence Tests

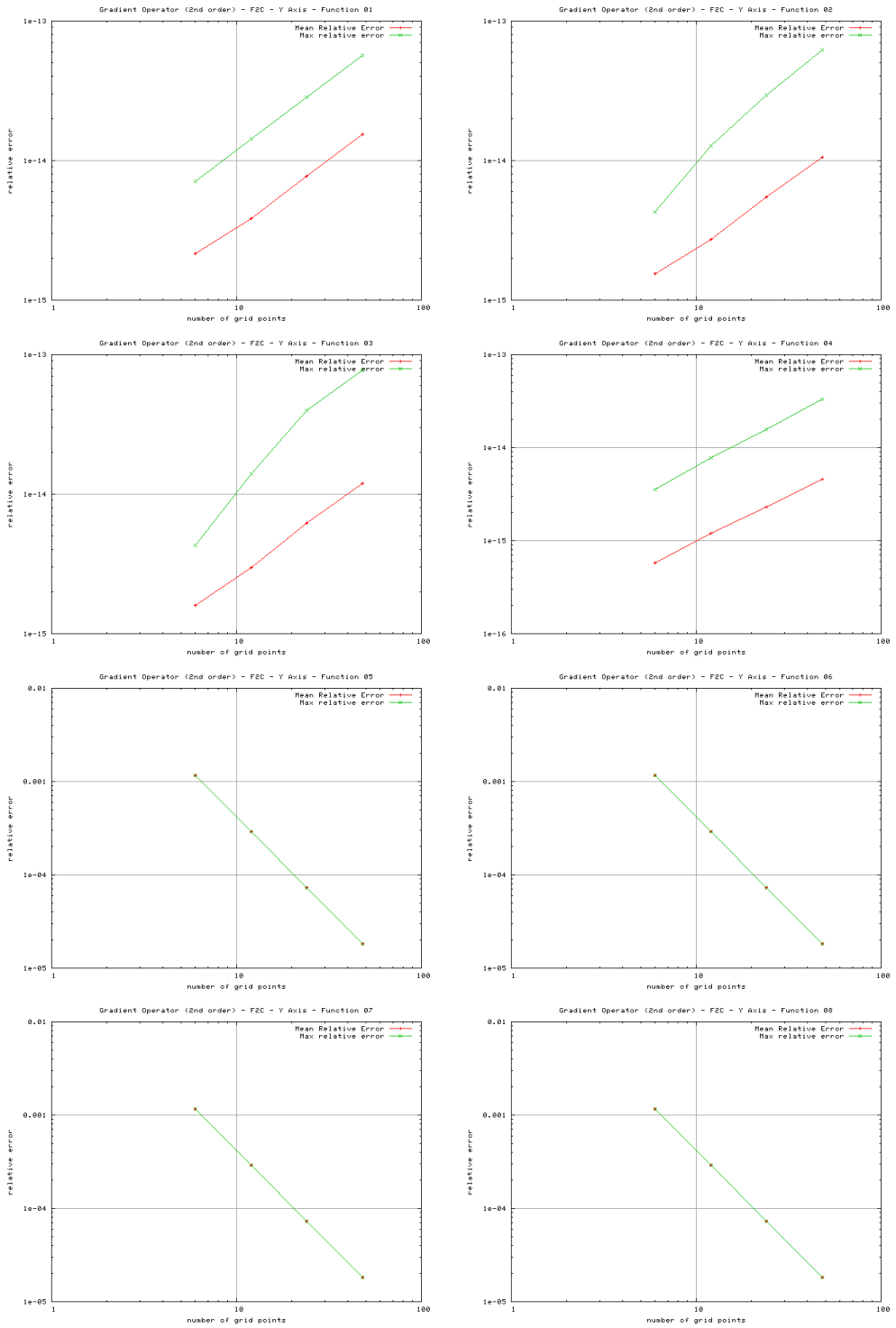

Figure 1.11: Gradient Operator (2nd order) - F2C - Y Axis - Convergence Tests

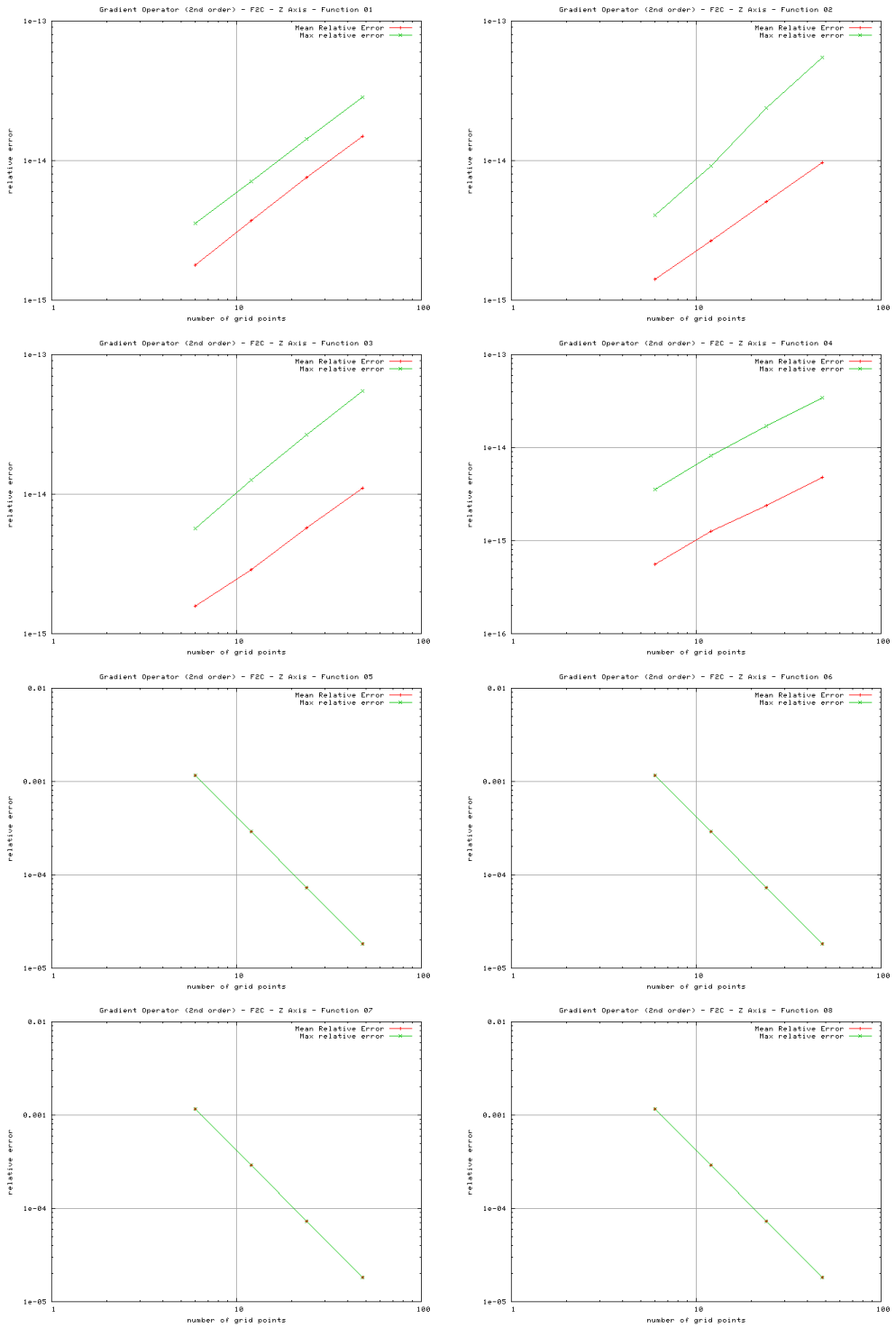

Figure 1.12: Gradient Operator (2nd order) - F2C - Y Axis - Convergence Tests

1.1.5 Divergence (2nd Order) Operator - C2F

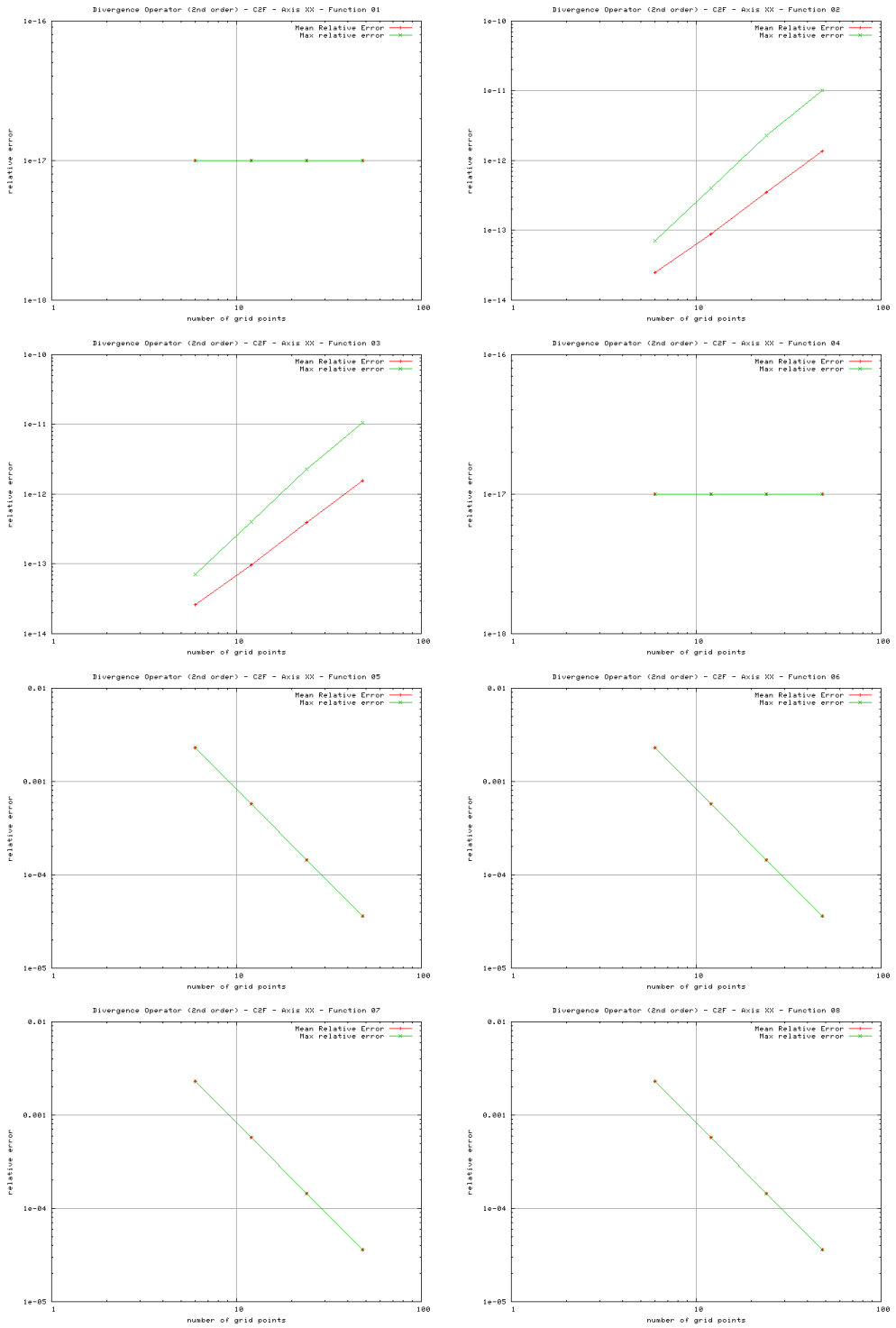

Figure 1.13: Divergence Operator (2nd order) - C2F - XX Axis - Convergence Tests

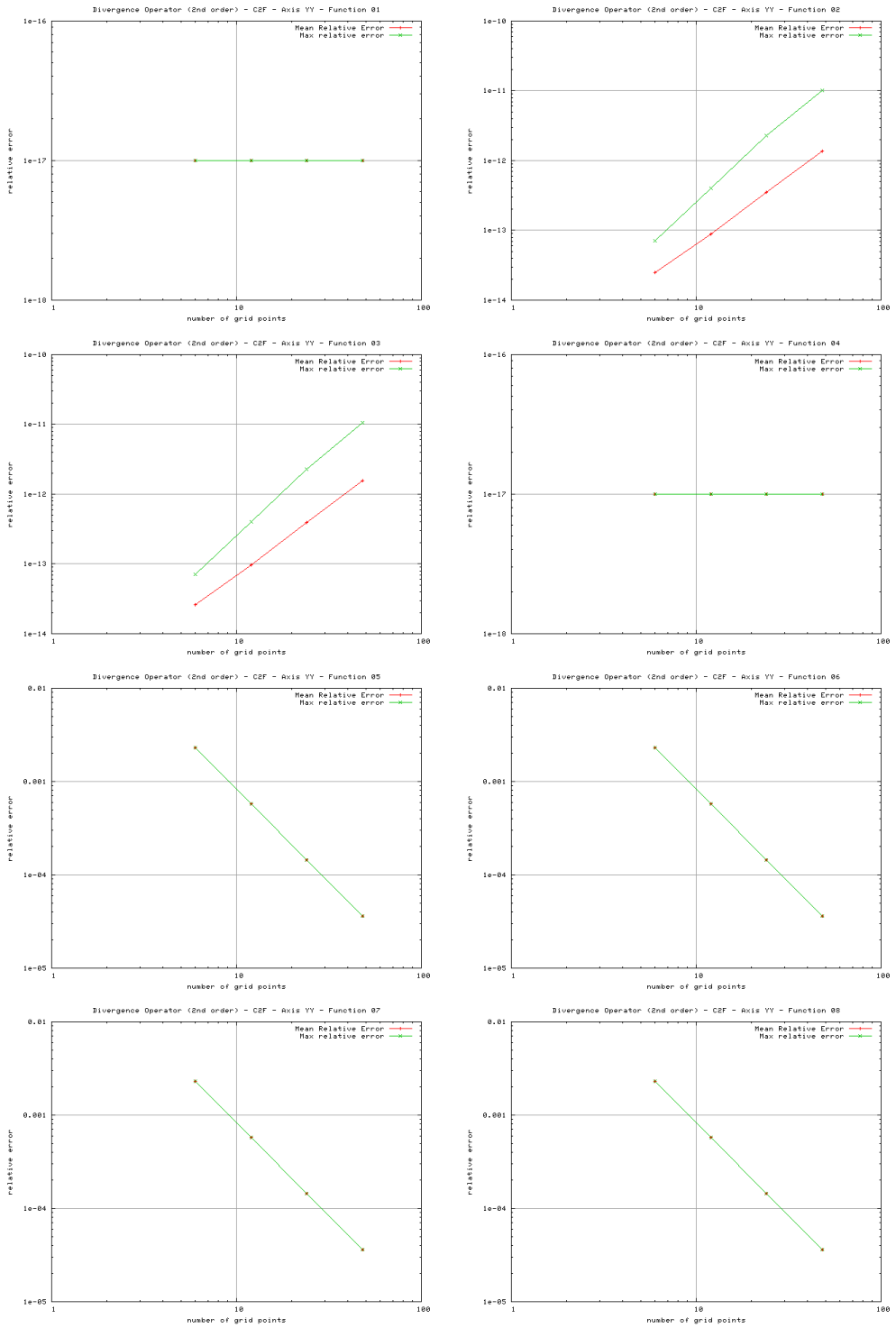

Figure 1.14: Divergence Operator (2nd order) - C2F - YY Axis - Convergence Tests

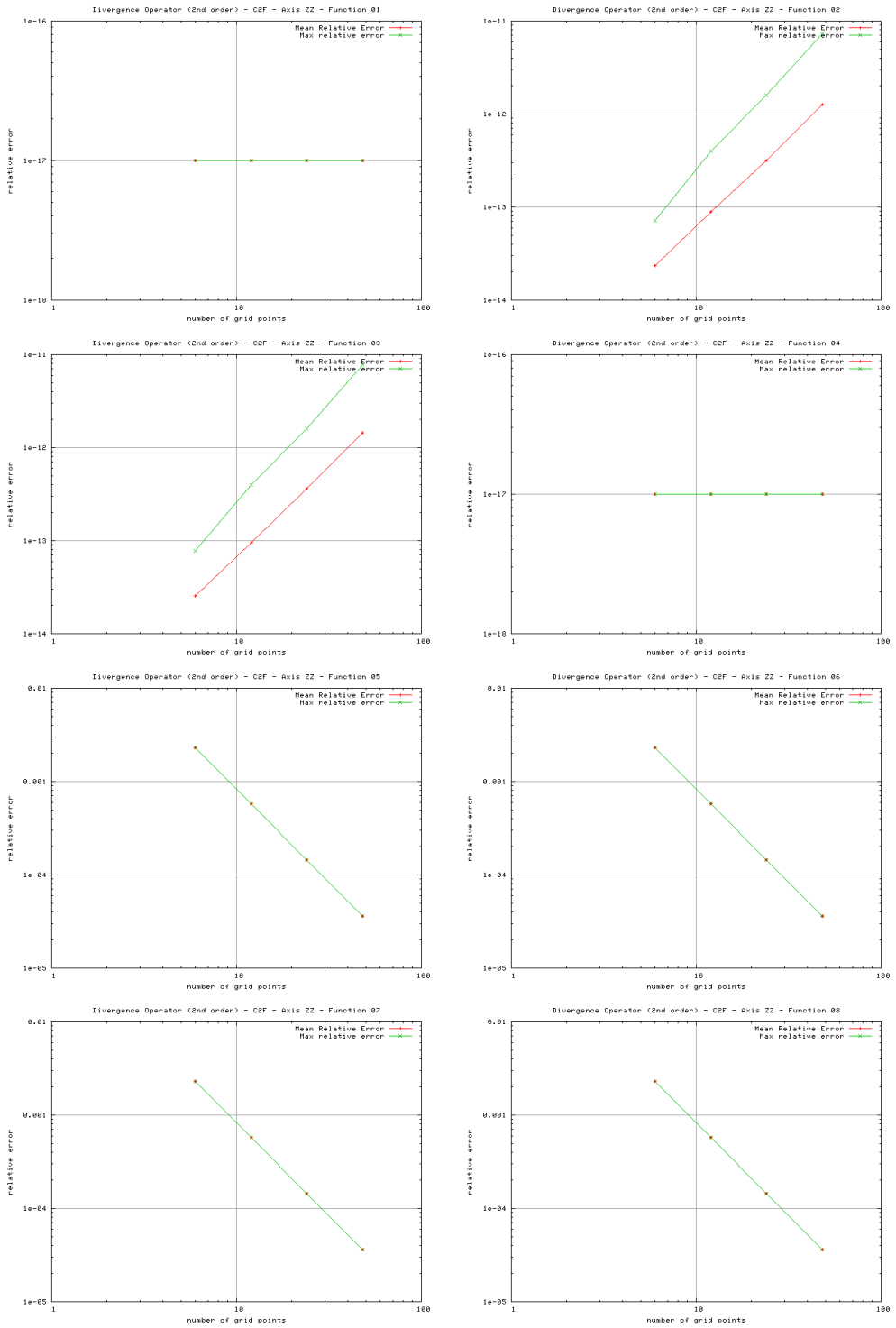

Figure 1.15: Divergence Operator (2nd order) - C2F - ZZ Axis - Convergence Tests

1.1.6 Divergence (2nd Order) Operator - F2C

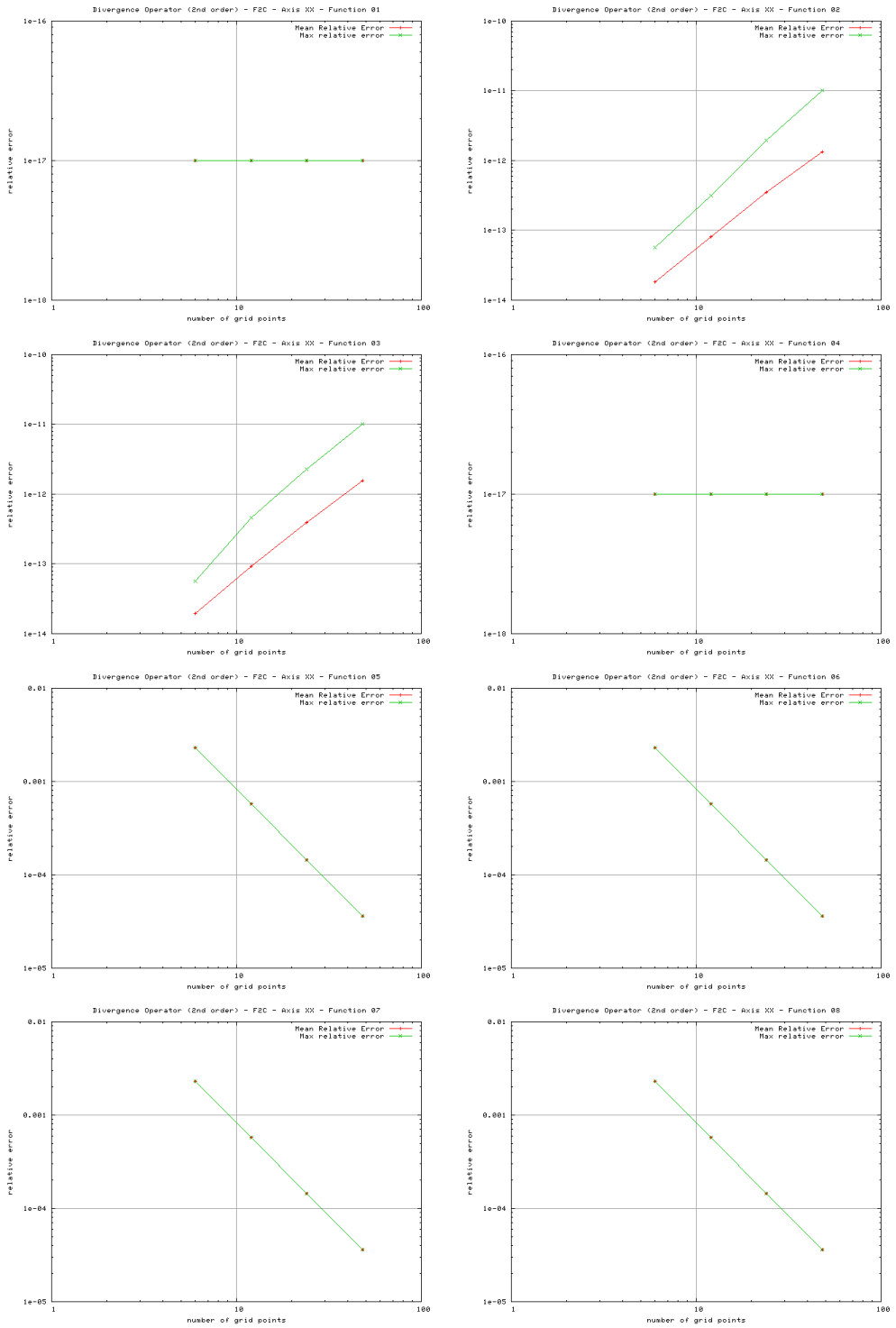

Figure 1.16: Divergence Operator (2nd order) - F2C- XX Axis - Convergence Tests

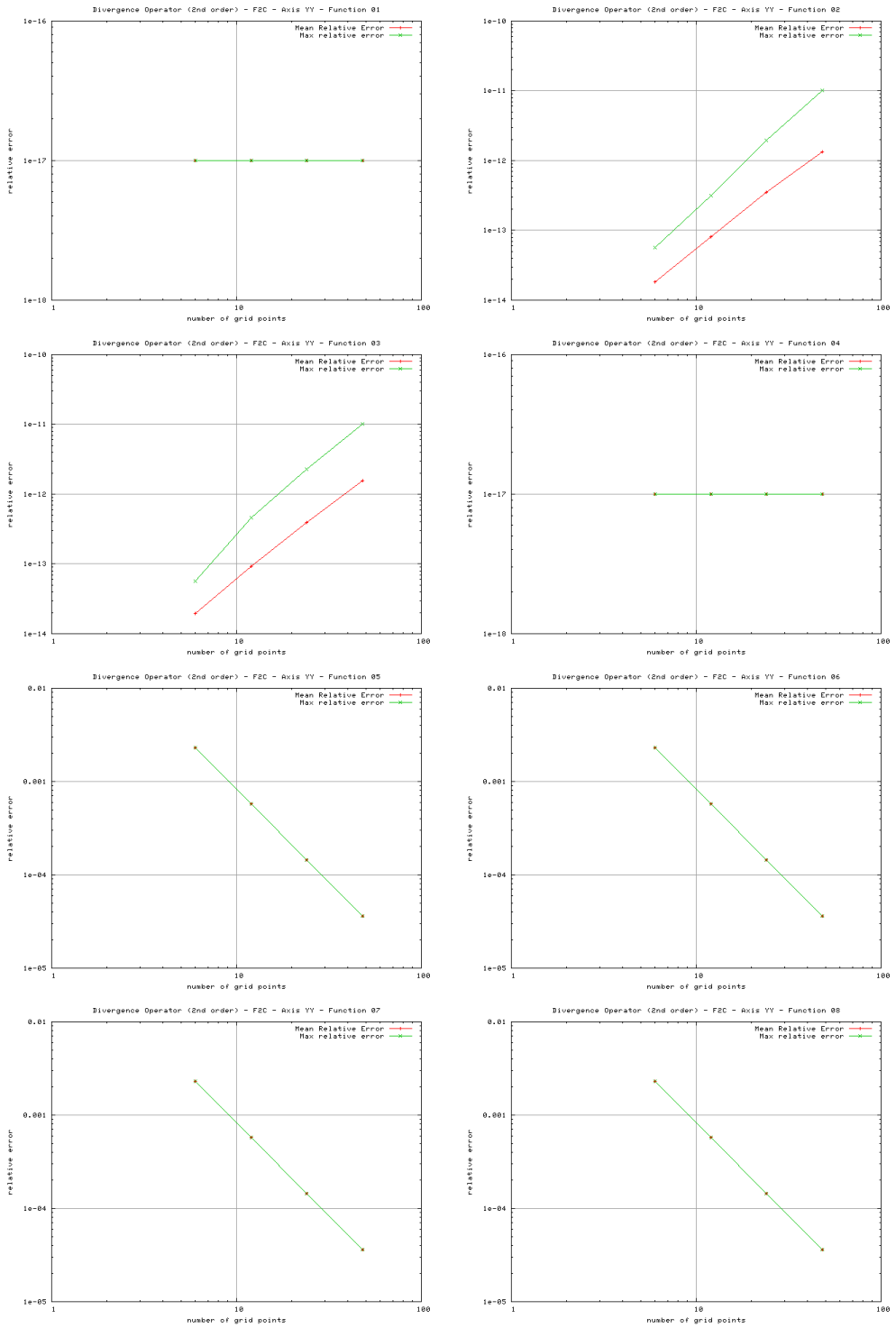

Figure 1.17: Divergence Operator (2nd order) - F2C- YY Axis - Convergence Tests

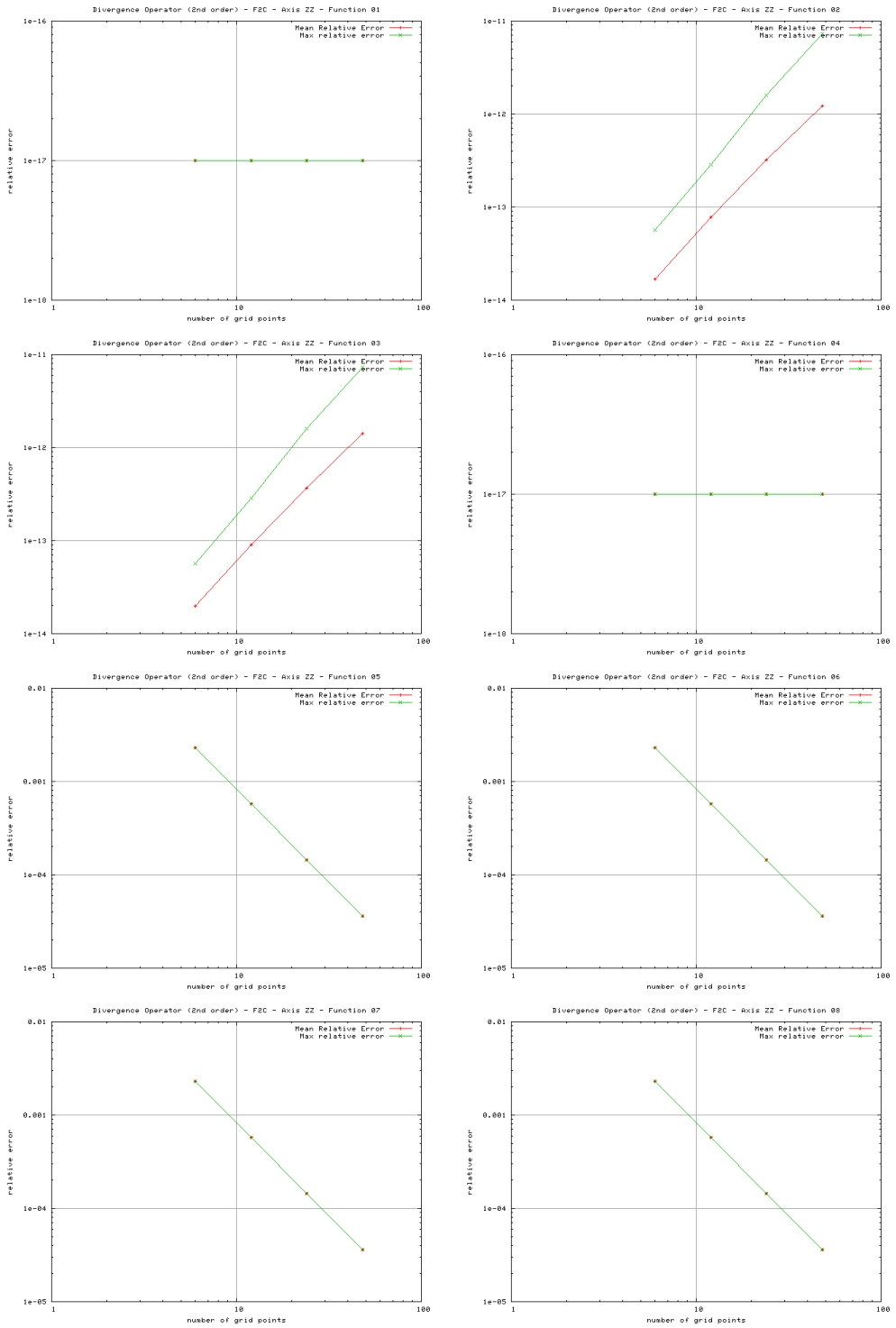

Figure 1.18: Divergence Operator (2nd order) - F2C- ZZ Axis - Convergence Tests

1.1.7 Mixed Derivatives

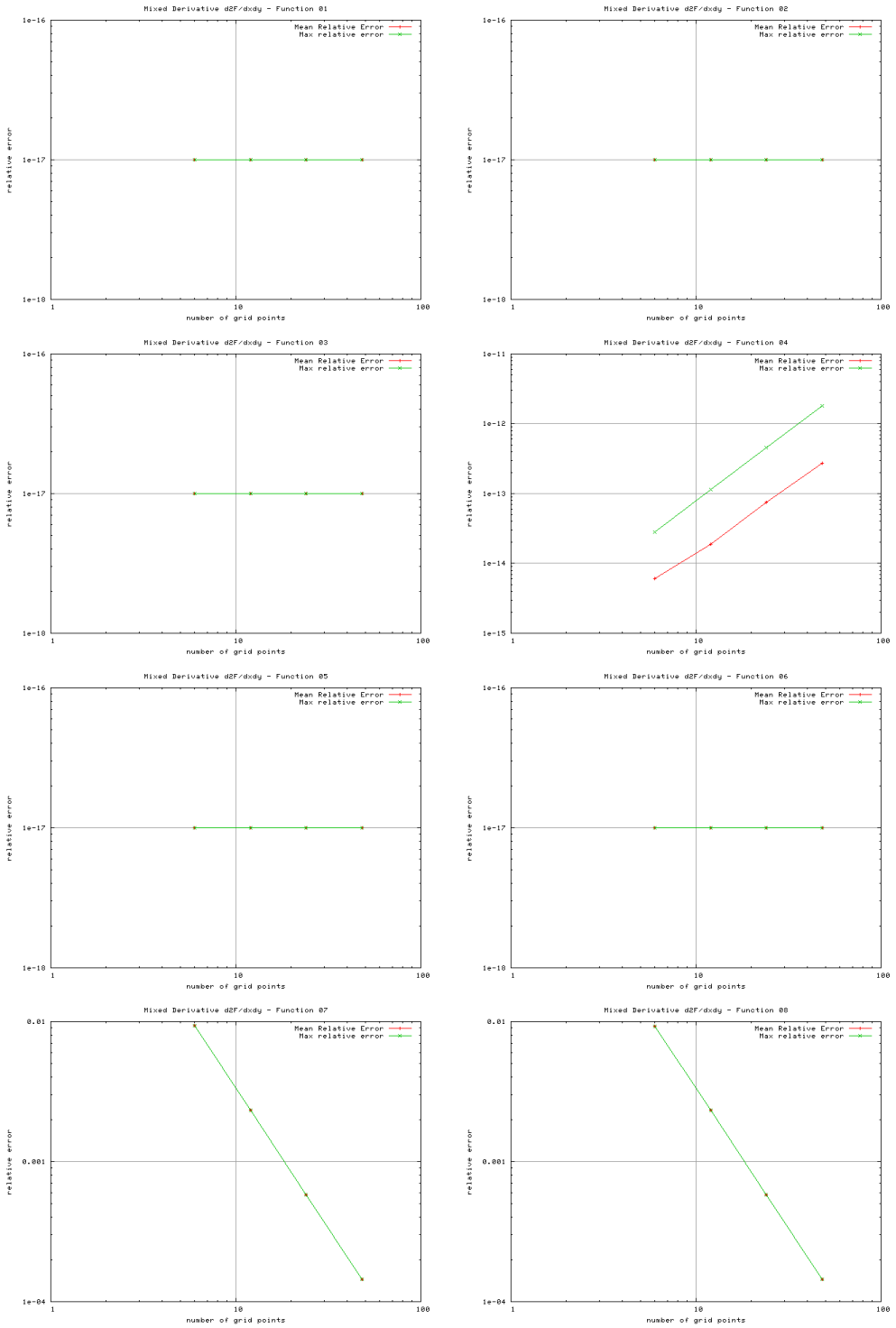

Figure 1.19: Mixed Derivative - XY Axis - Convergence Tests

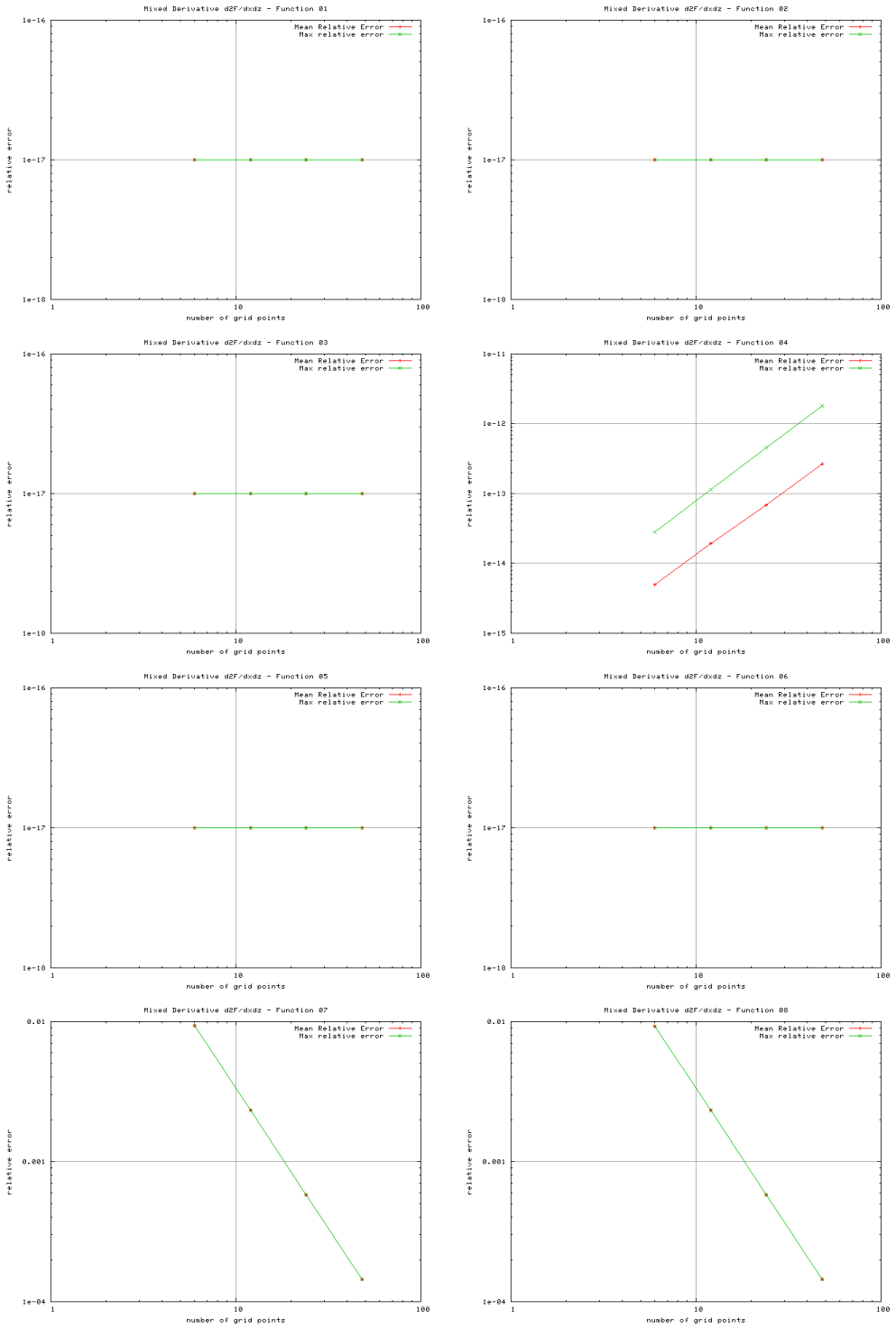

Figure 1.20: Mixed Derivative - XZ Axis - Convergence Tests

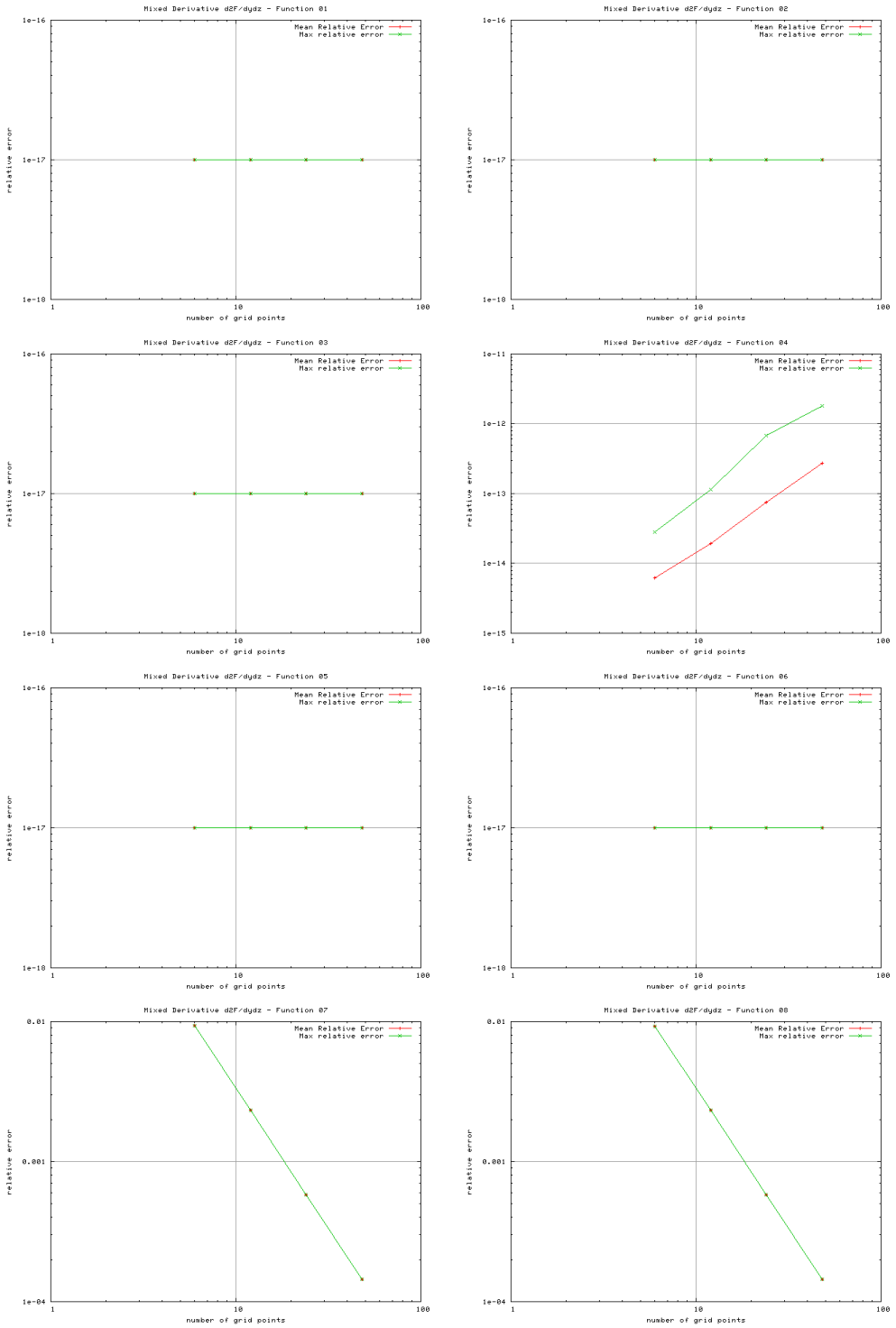

Figure 1.21: Mixed Derivative - YZ Axis - Convergence Tests

1.1.8 Laplacian (2nd Order) Operator

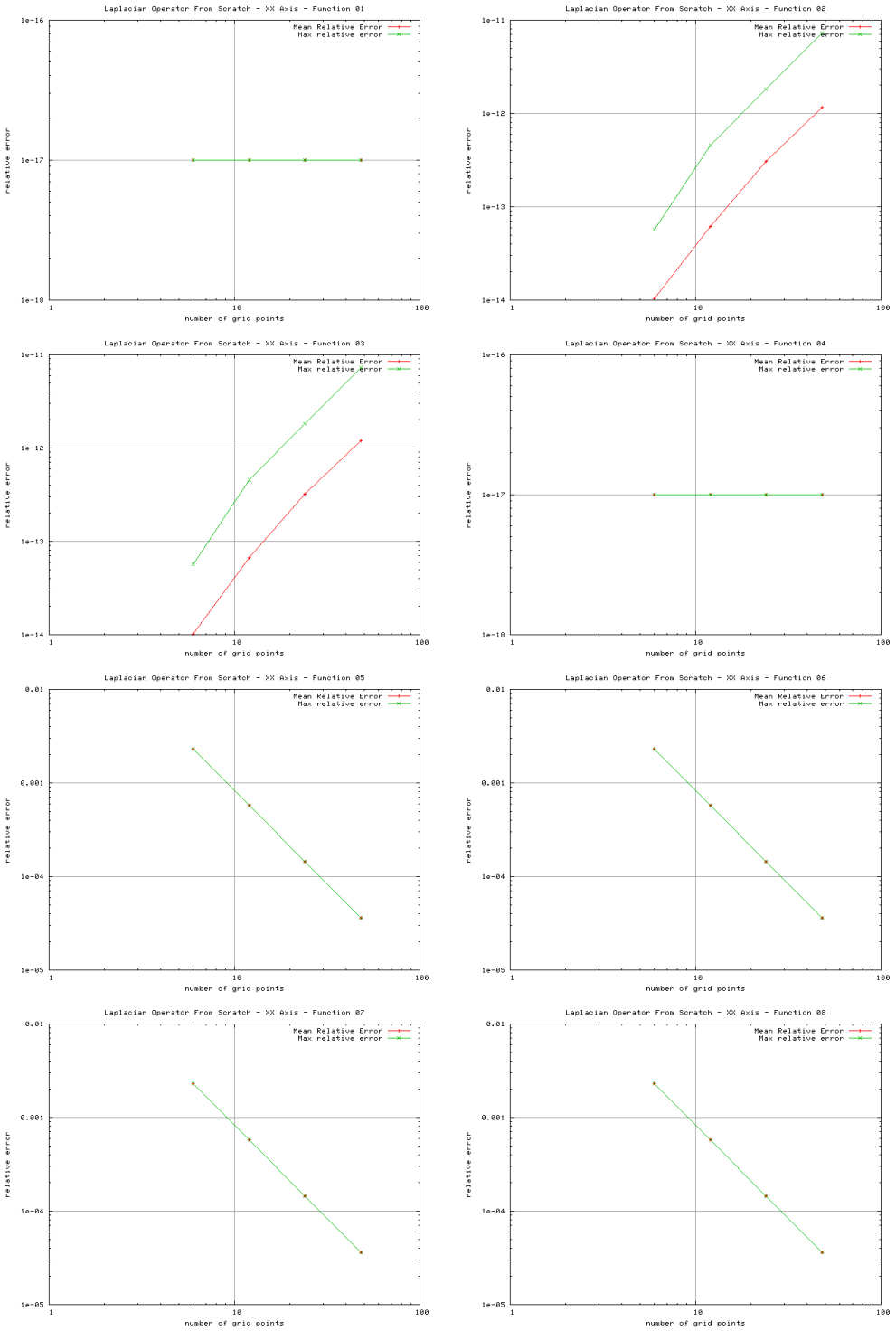

Figure 1.22: Laplacian - XX Axis - Convergence Tests

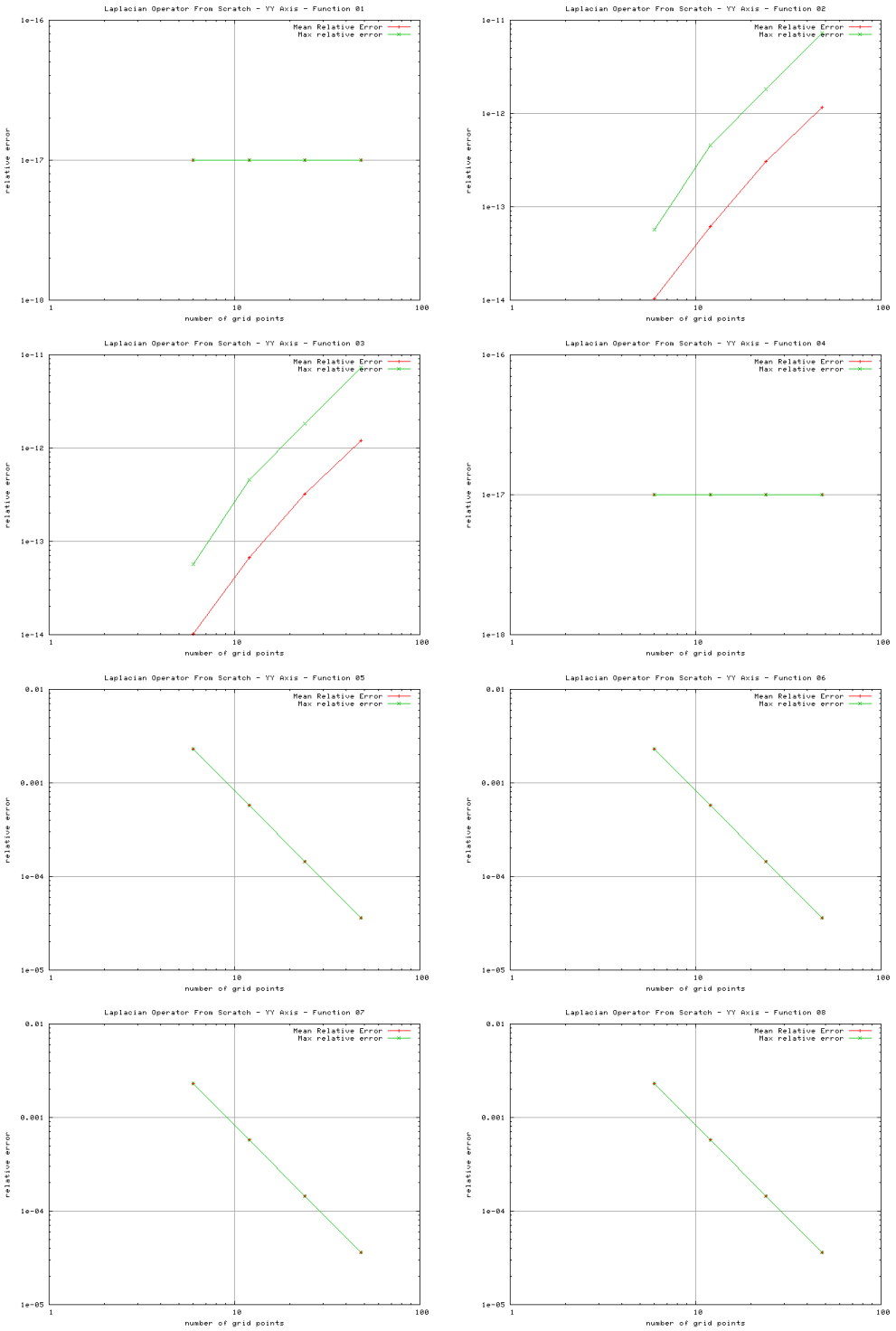

Figure 1.23: Laplacian - YY Axis - Convergence Tests

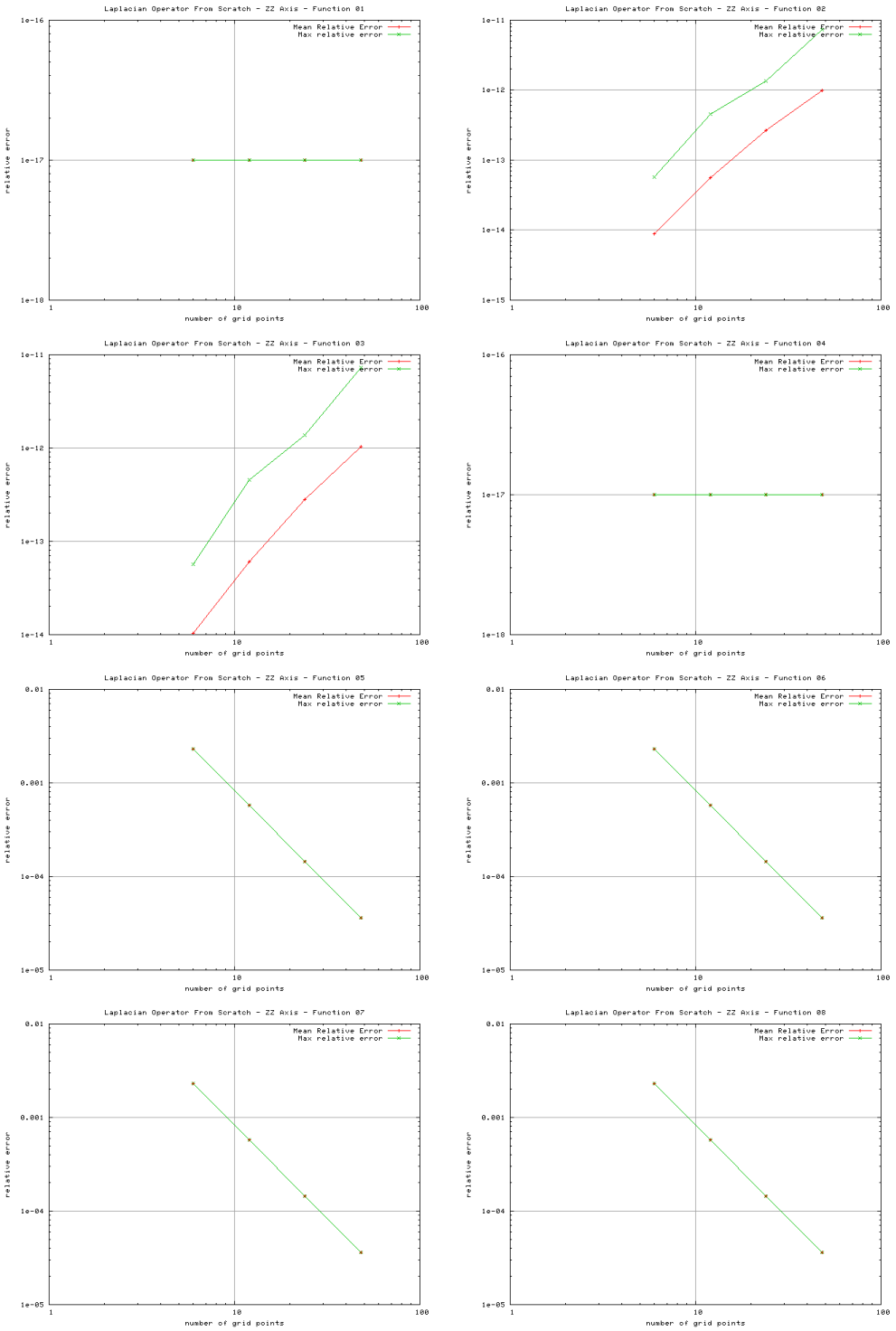

Figure 1.24: Laplacian - ZZ Axis - Convergence Tests