

Test Results for Mesh Hydro Code

This computer

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1 Advection

1.1 Piecewise Constant

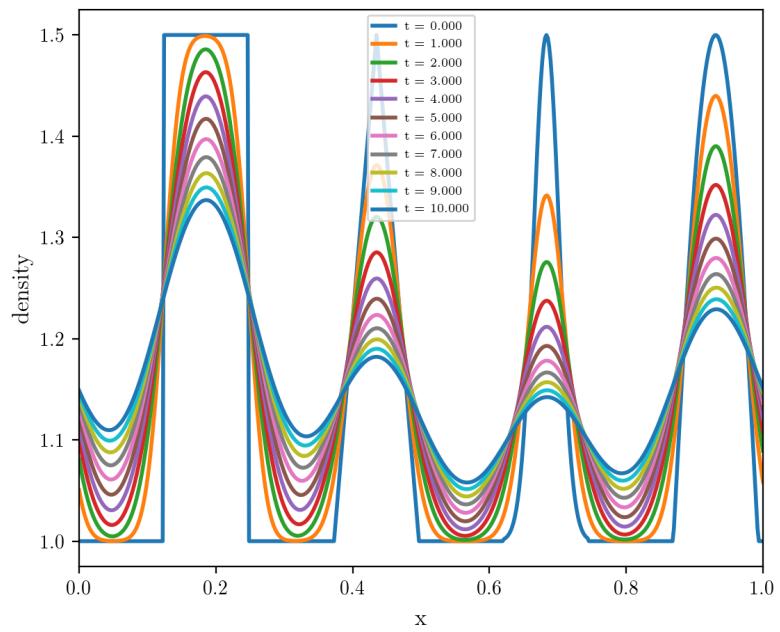


Figure 1: Expected result 1D

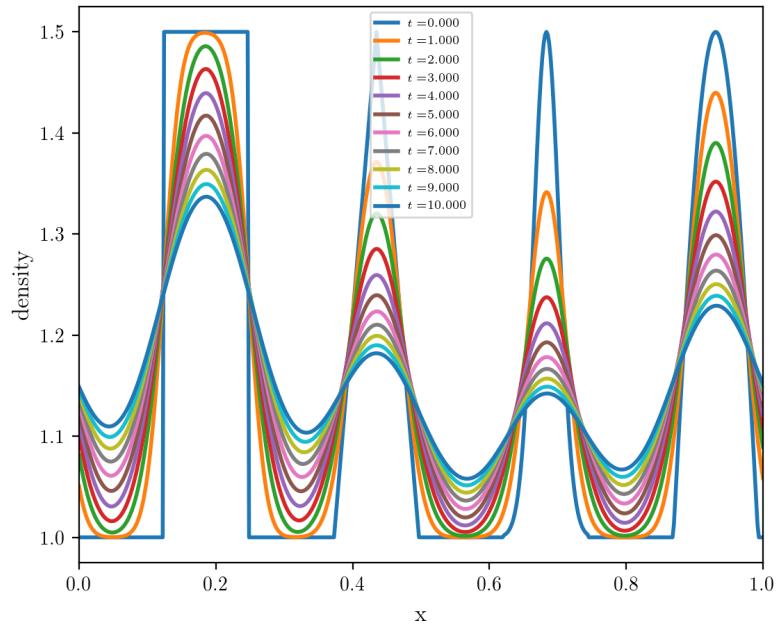


Figure 2: Obtained result 1D

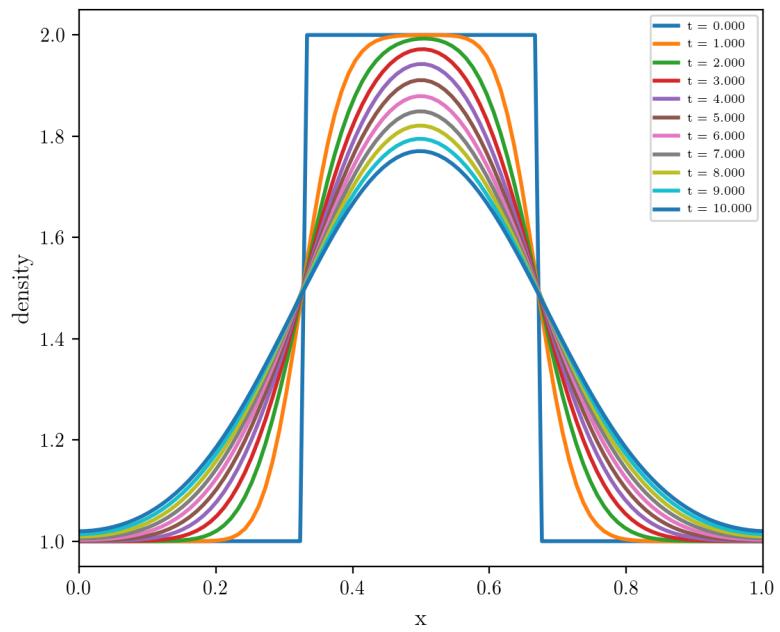


Figure 3: Expected result 1D negative velocity

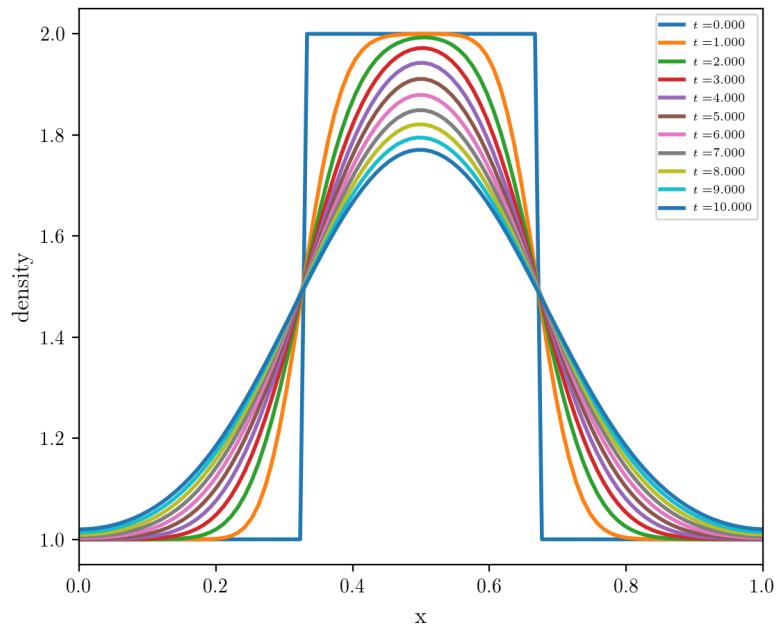


Figure 4: Obtained result 1D negative velocity

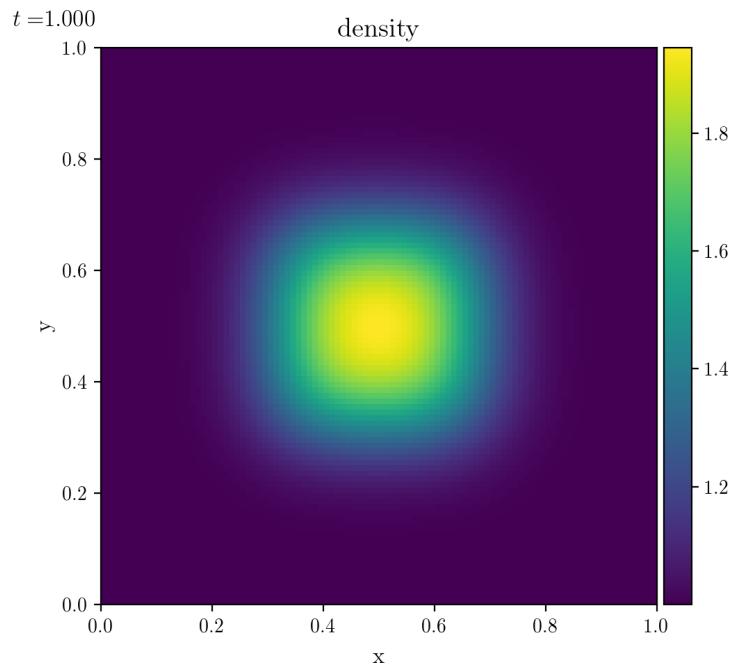


Figure 5: Expected result 2D

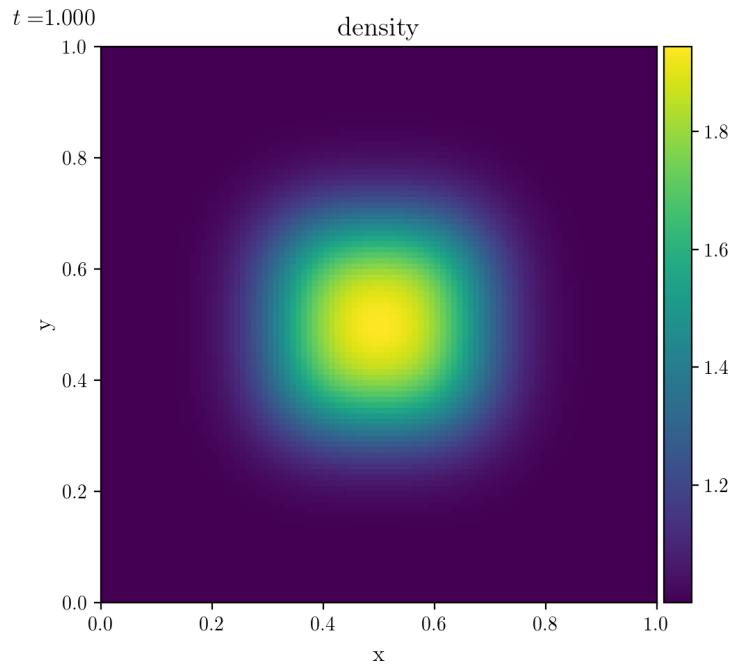


Figure 6: Obtained result 2D

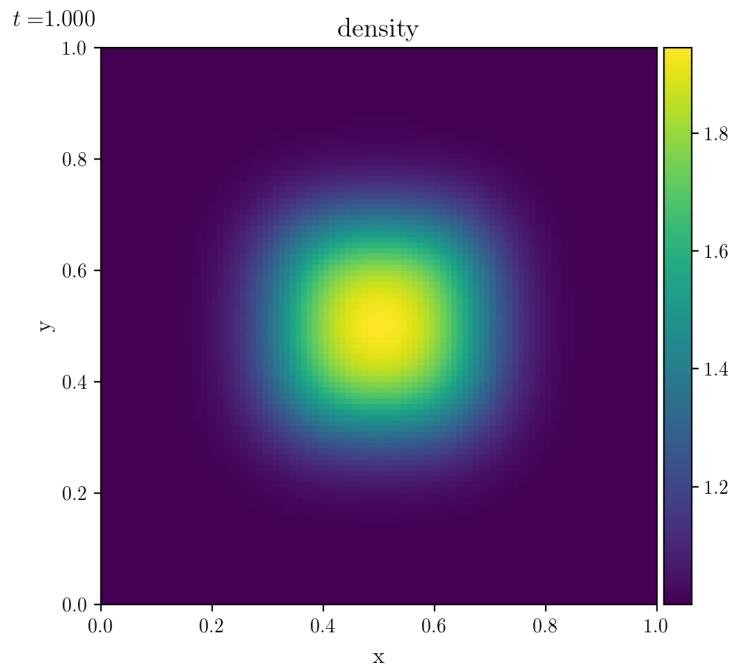


Figure 7: Expected result 2D negative velocity

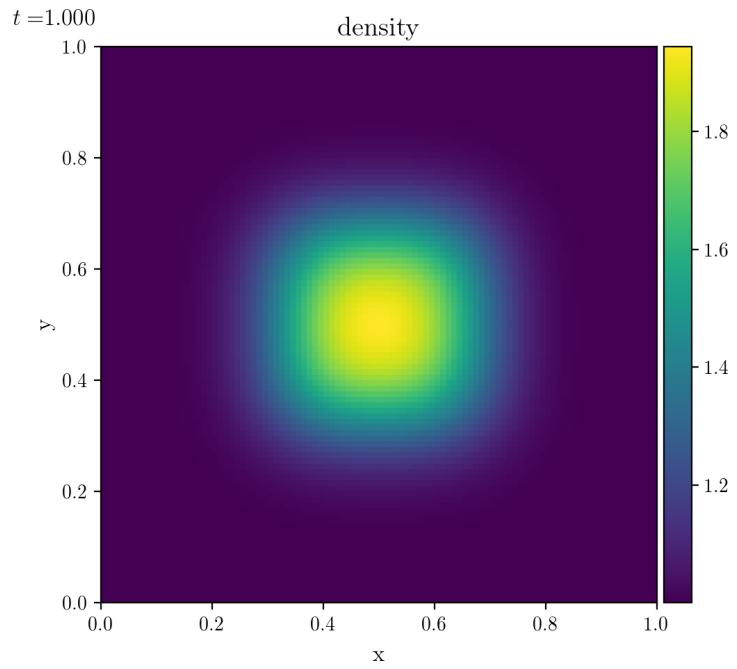


Figure 8: Obtained result 2D negative velocity

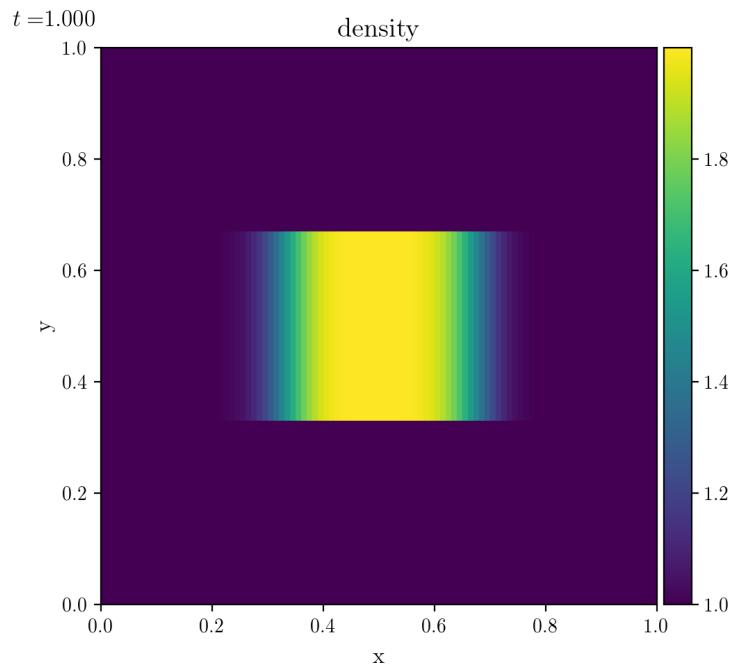


Figure 9: Expected result 2D velocity in x direction only

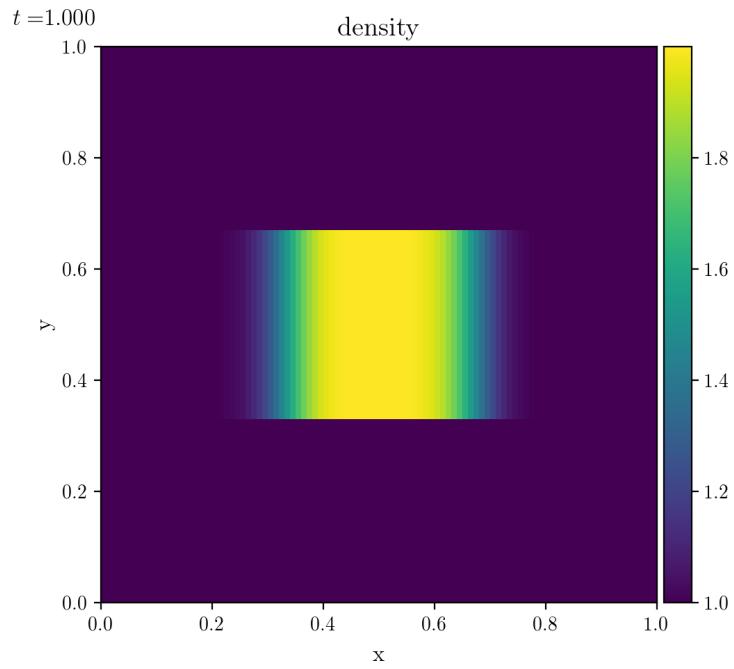


Figure 10: Obtained result 2D velocity in x direction only

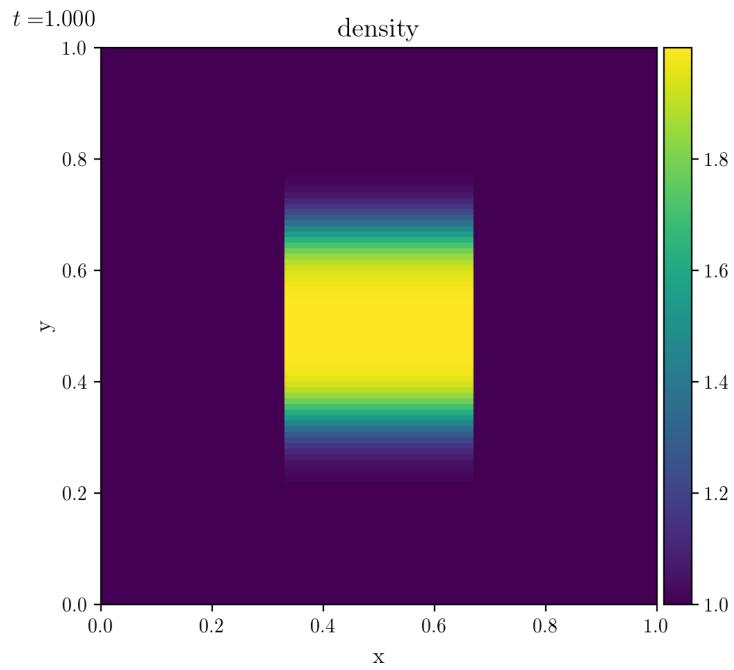


Figure 11: Expected result 2D velocity in y direction only

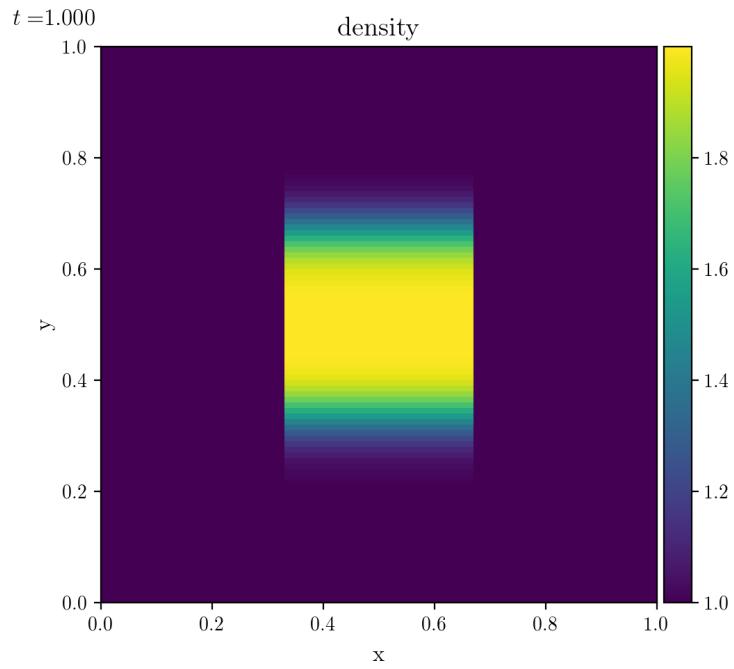


Figure 12: Obtained result 2D velocity in y direction only

1.2 Piecewise Linear

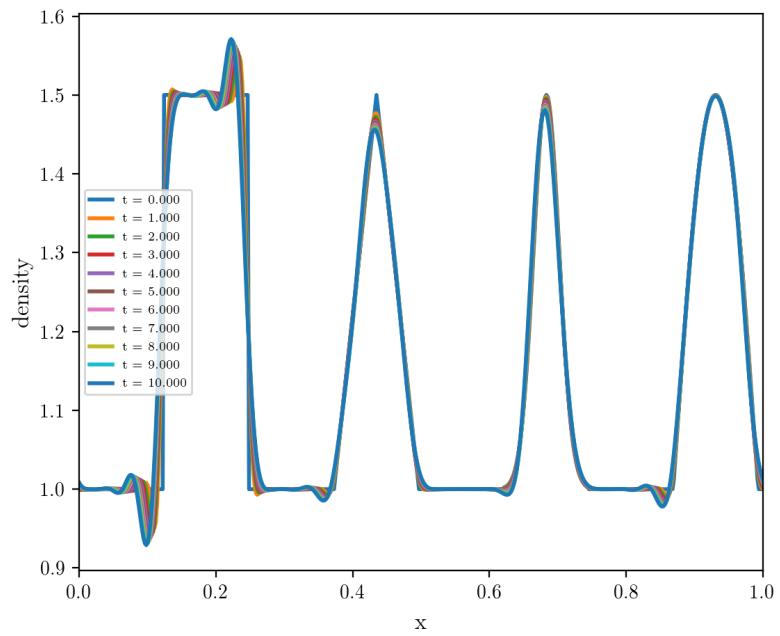


Figure 13: Expected result 1D

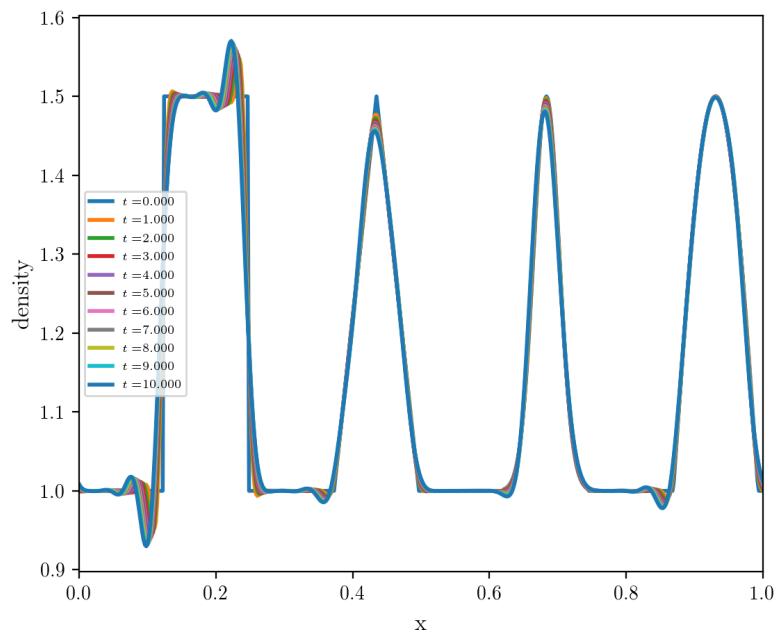


Figure 14: Obtained result 1D

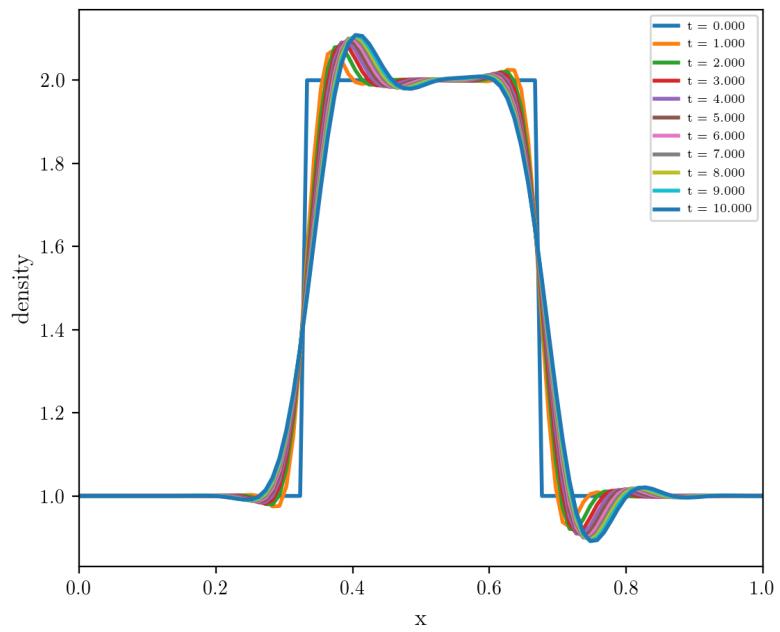


Figure 15: Expected result 1D negative velocity

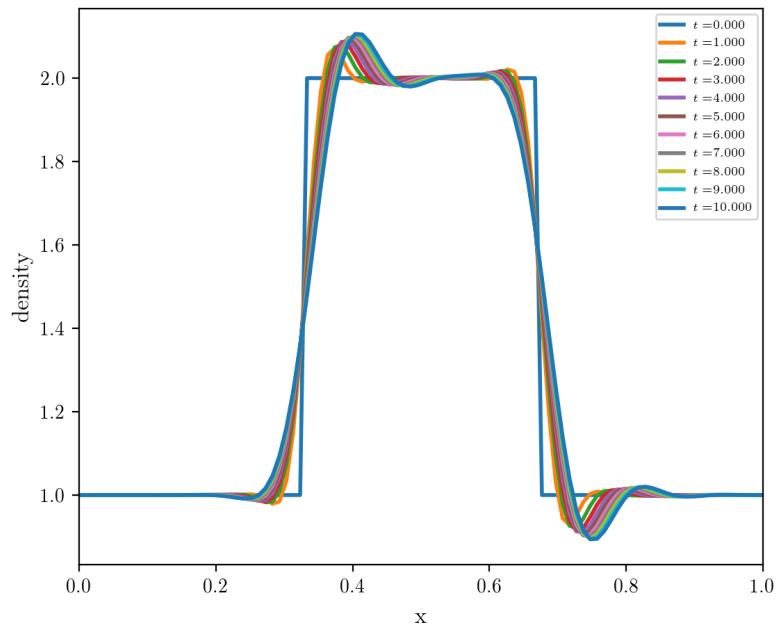


Figure 16: Obtained result 1D negative velocity

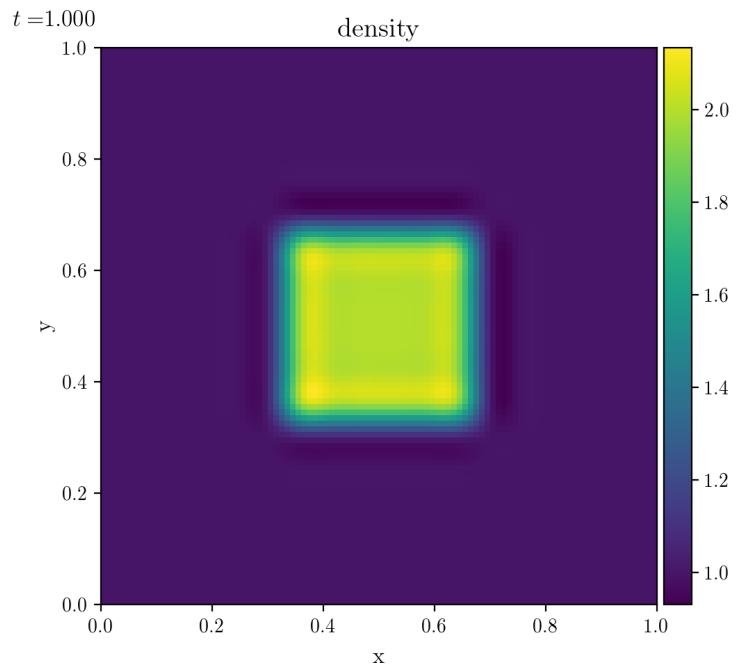


Figure 17: Expected result 2D

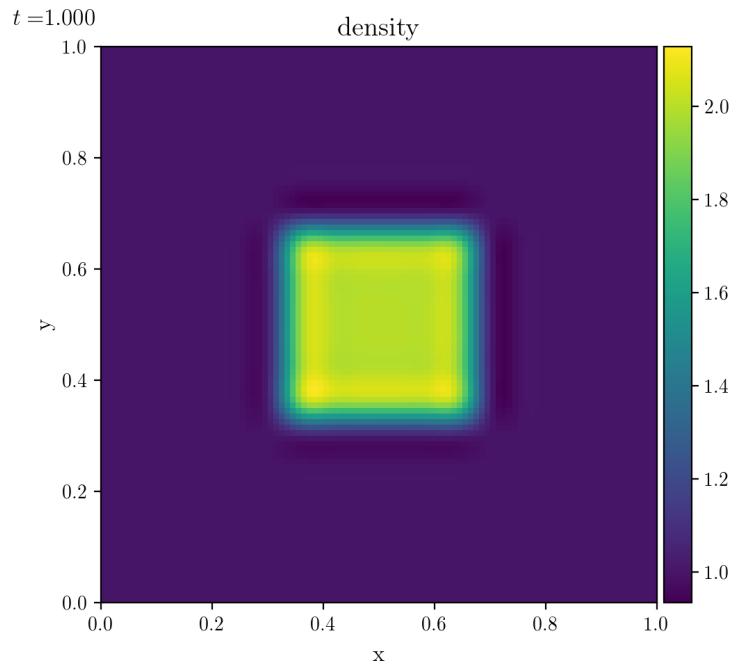


Figure 18: Obtained result 2D

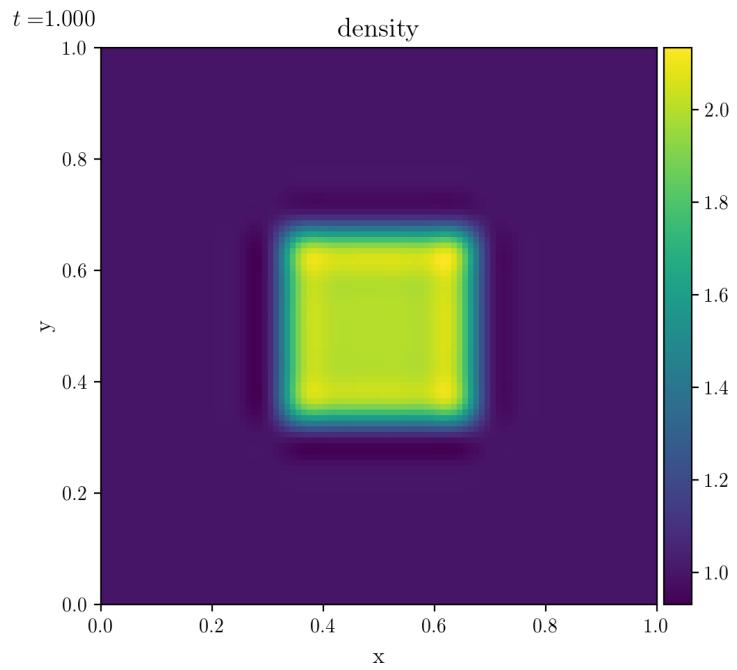


Figure 19: Expected result 2D negative velocity

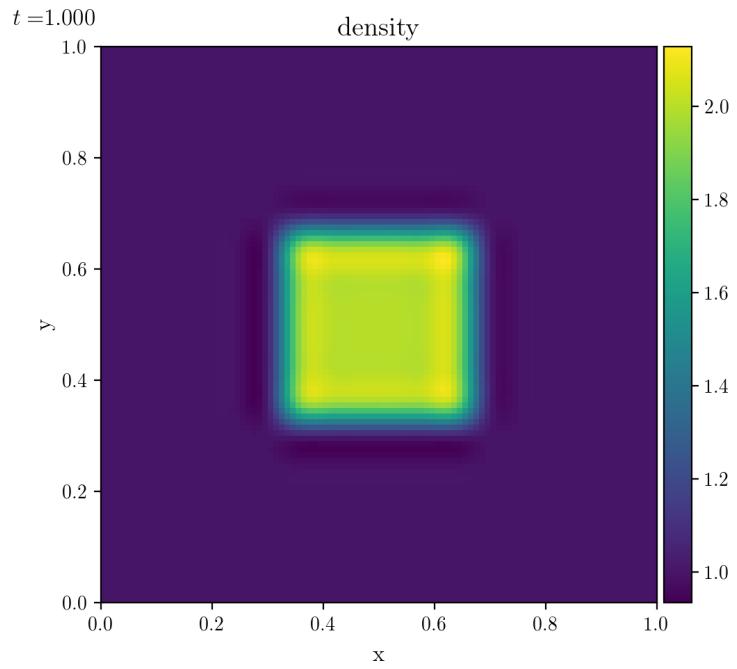


Figure 20: Obtained result 2D negative velocity

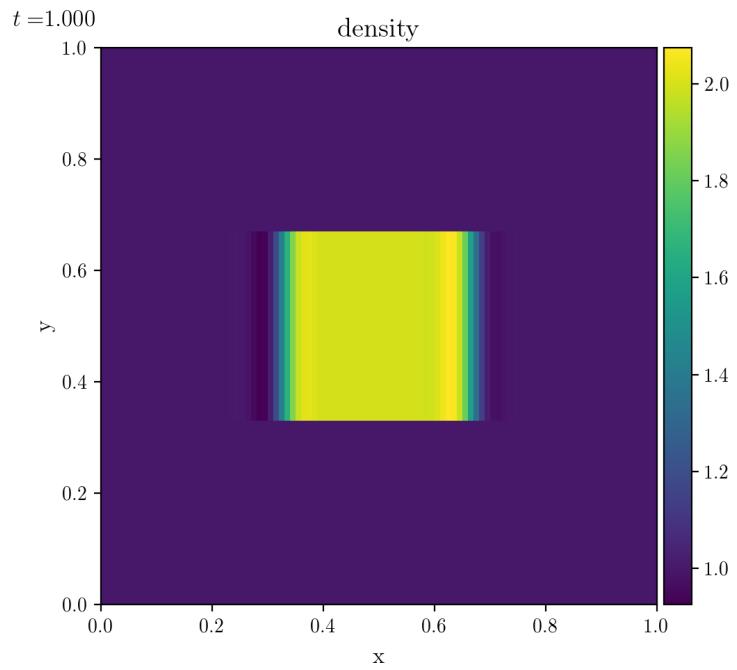


Figure 21: Expected result 2D velocity in x direction only

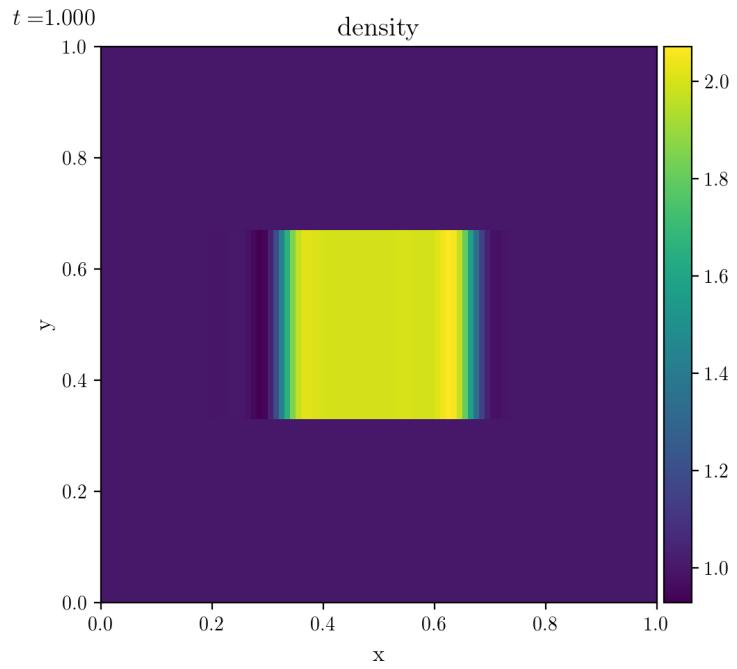


Figure 22: Obtained result 2D velocity in x direction only

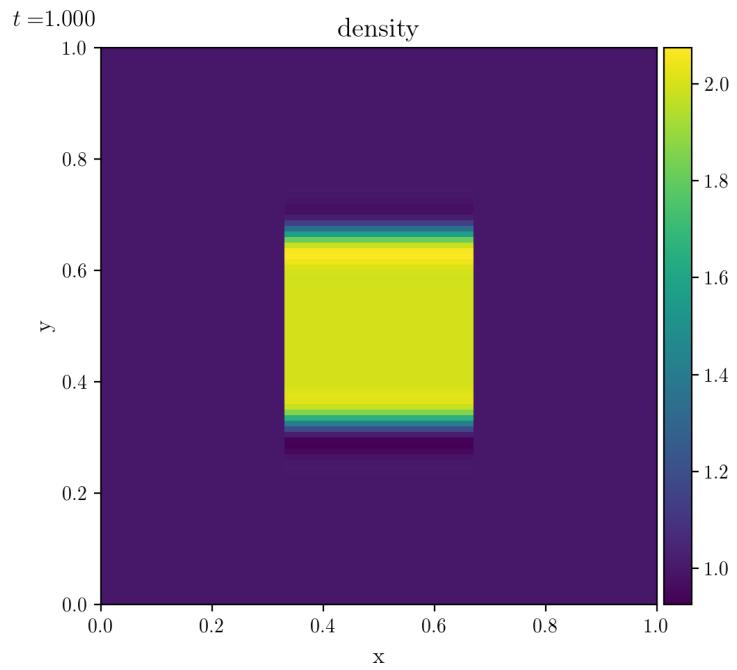


Figure 23: Expected result 2D velocity in y direction only

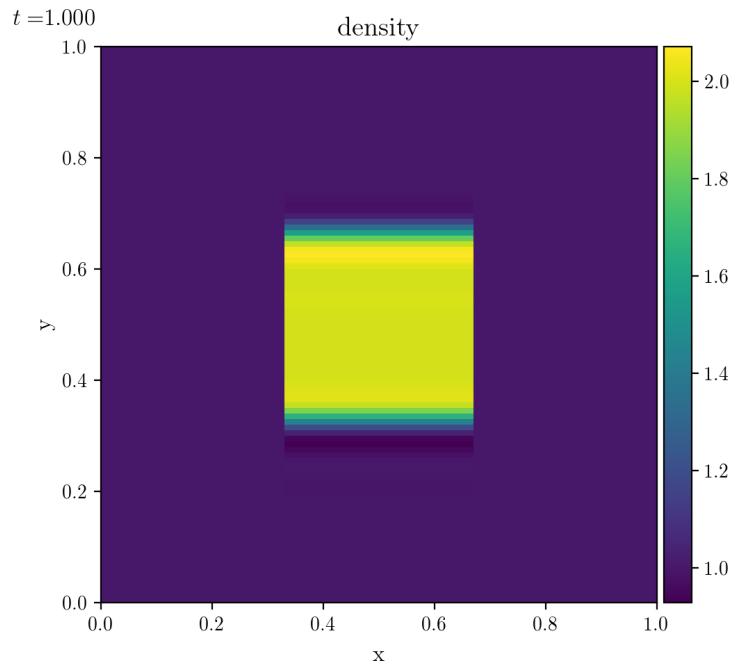


Figure 24: Obtained result 2D velocity in y direction only

1.3 Piecewise Linear with Slope Limiters

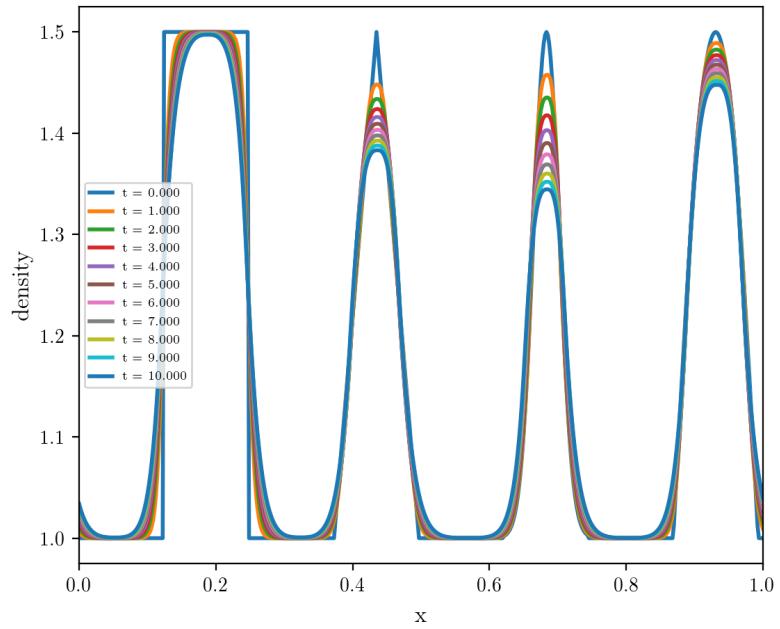


Figure 25: Minmod Slope Limiter. Expected result 1D

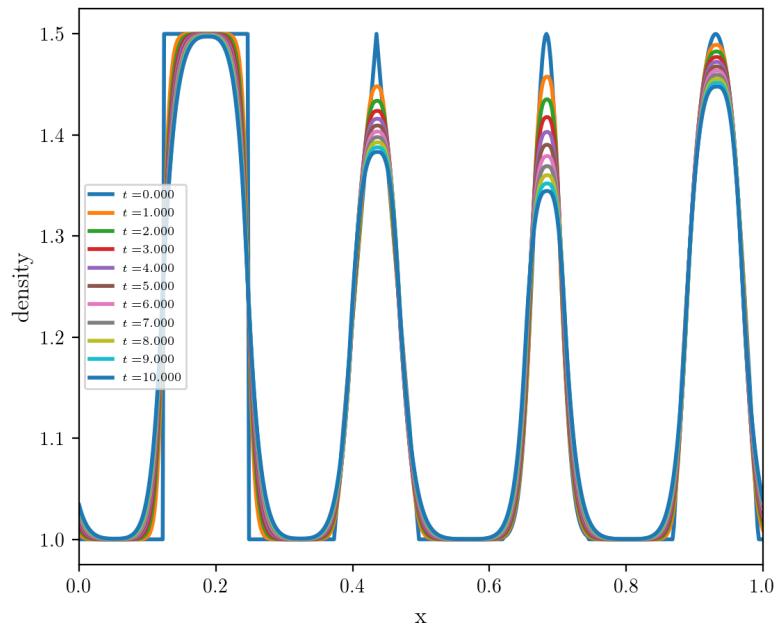


Figure 26: Minmod Slope Limiter. Obtained result 1D

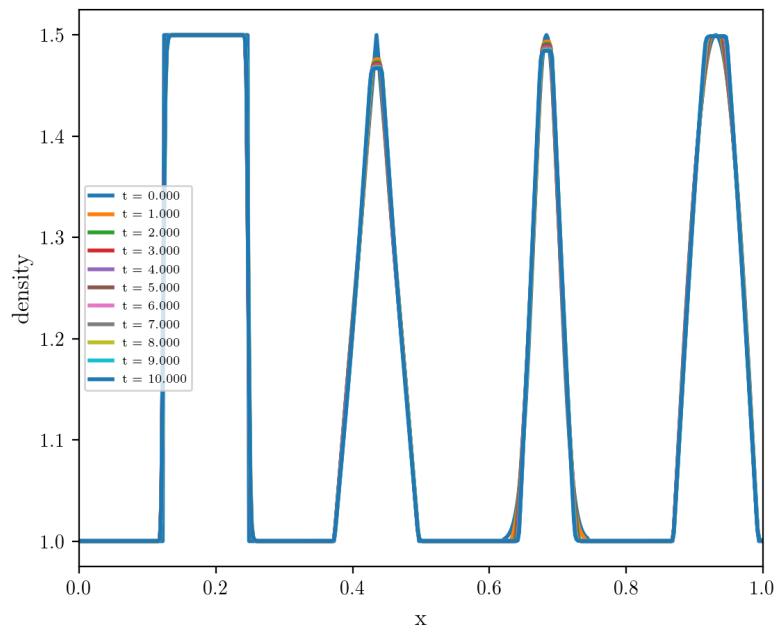


Figure 27: Superbee slope limiter. Expected result 1D negative velocity

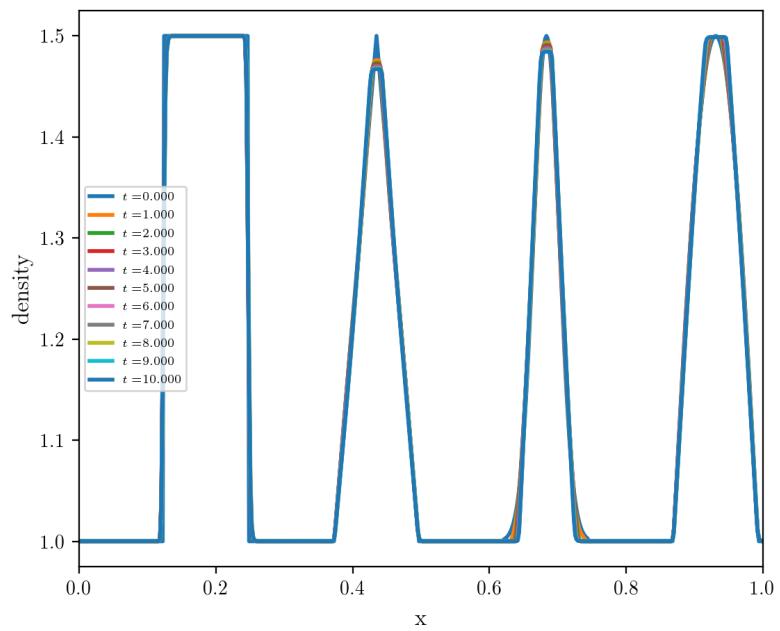


Figure 28: Superbee slope limiter. Obtained result 1D negative velocity

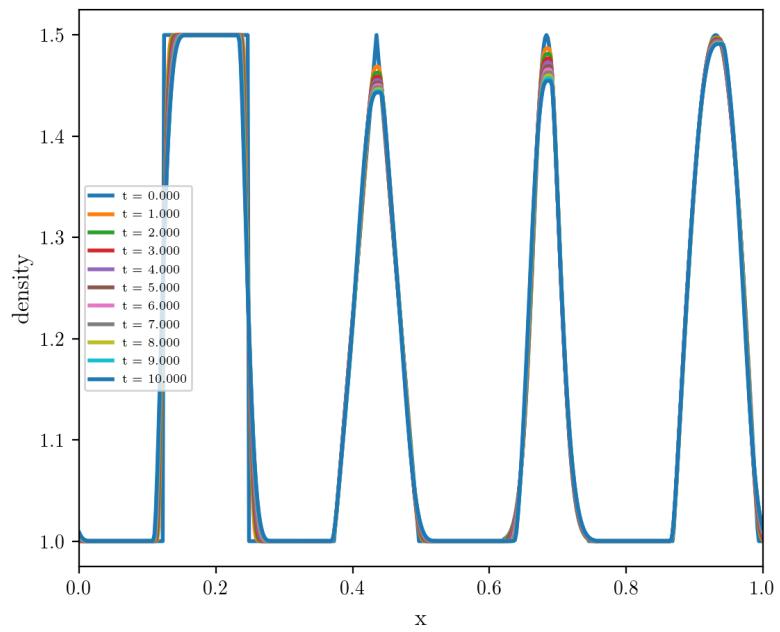


Figure 29: Monotonized central limiter. Expected result 1D

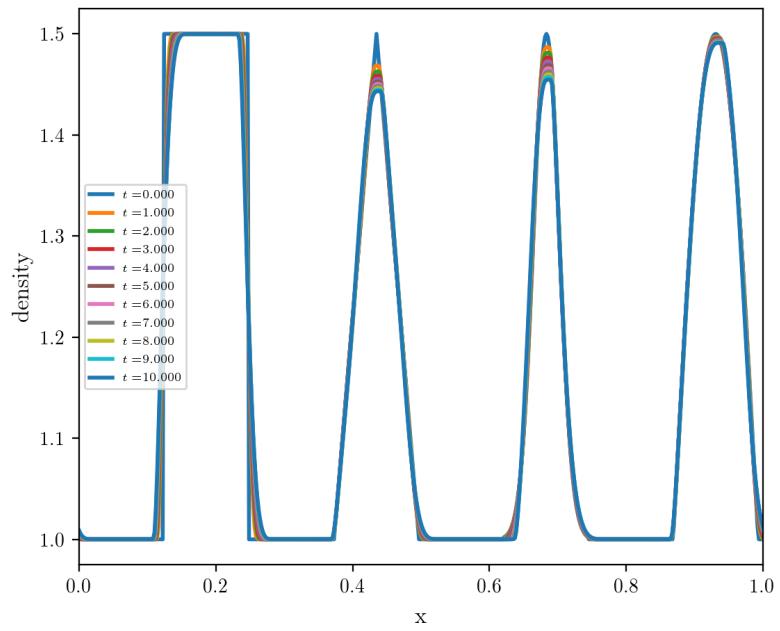


Figure 30: Monotonized central limiter. Obtained result 1D

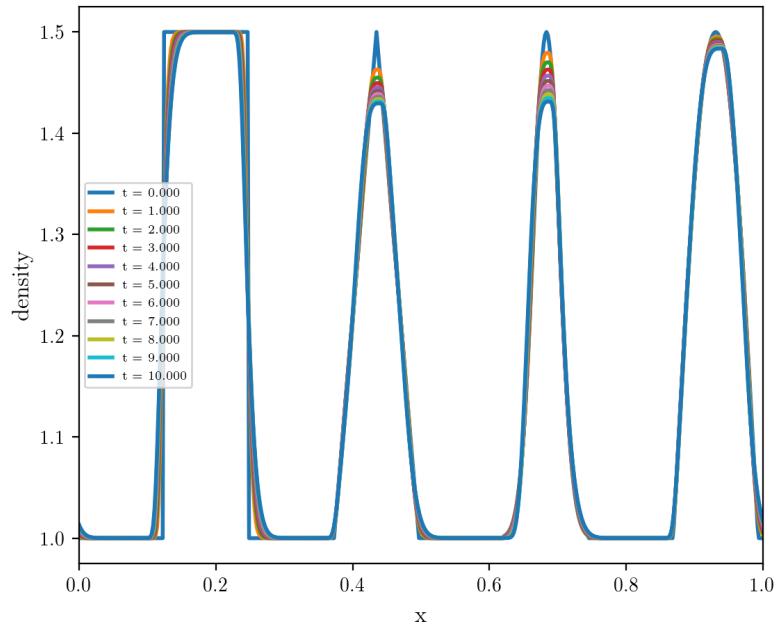


Figure 31: Van Leer Limiter. Expected result 1D

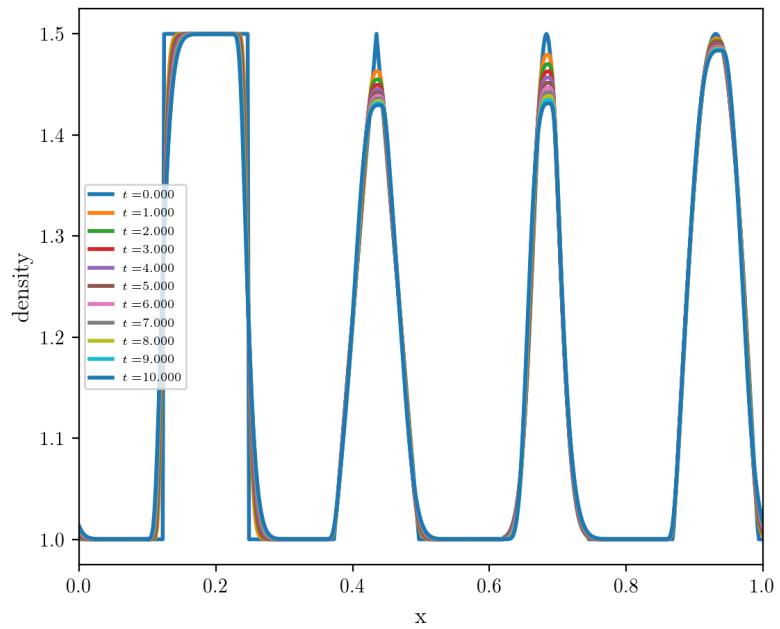


Figure 32: Van Leer Limiter. Obtained result 1D

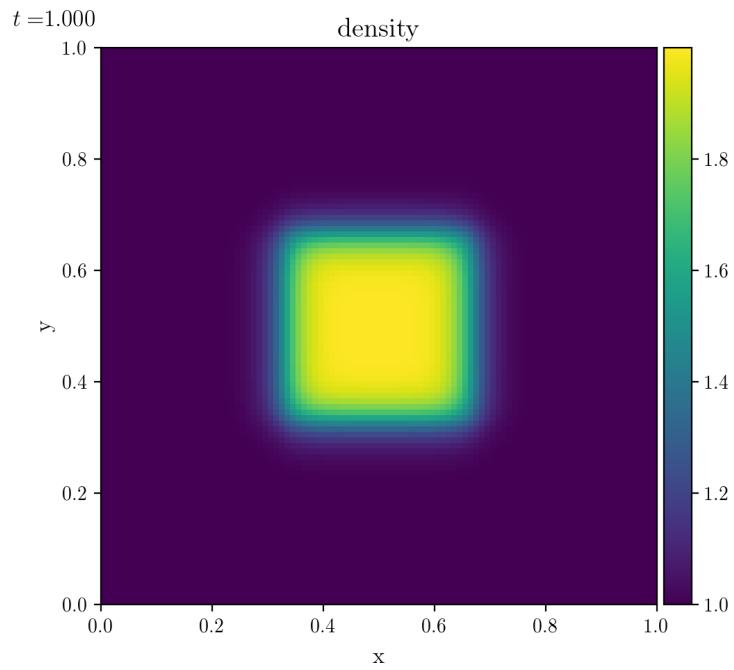


Figure 33: Minmod Slope Limiter. Expected result 2D

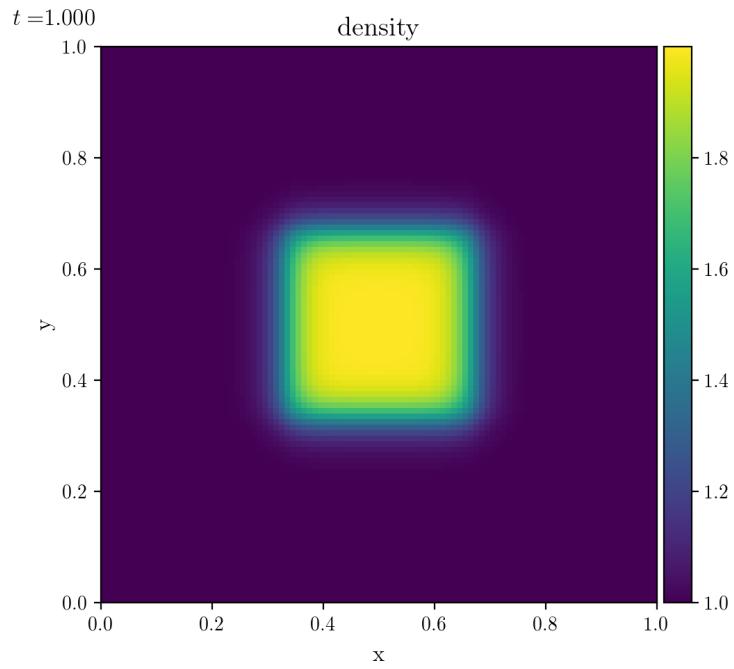


Figure 34: Minmod Slope Limiter. Obtained result 2D

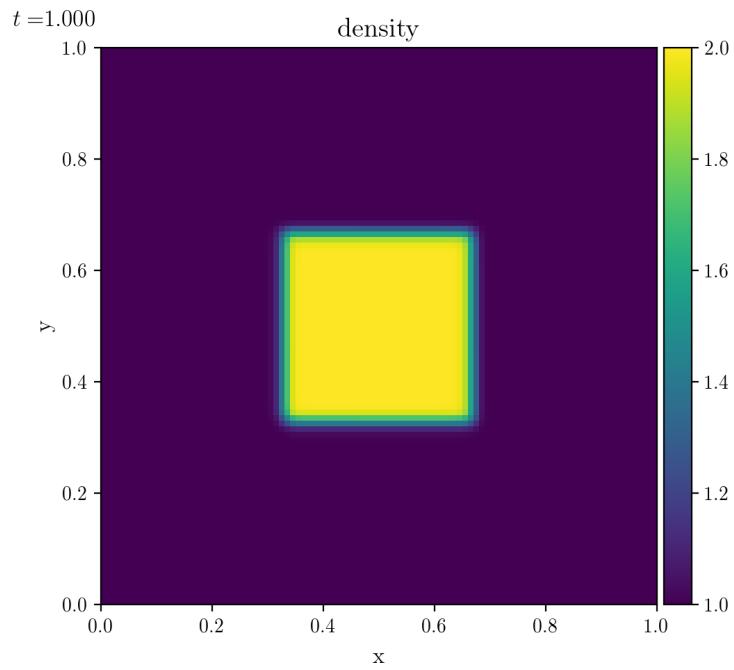


Figure 35: Superbee slope limiter. Expected result 2D negative velocity

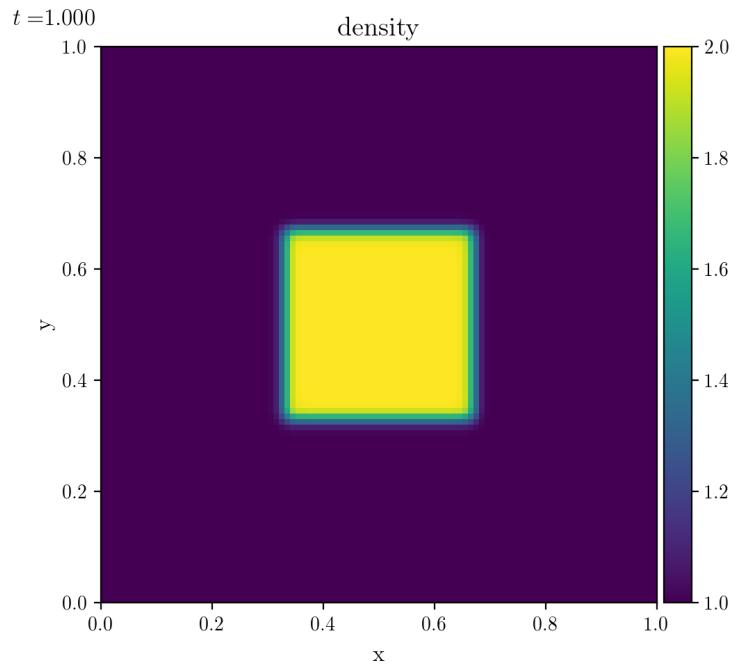


Figure 36: Superbee slope limiter. Obtained result 2D negative velocity

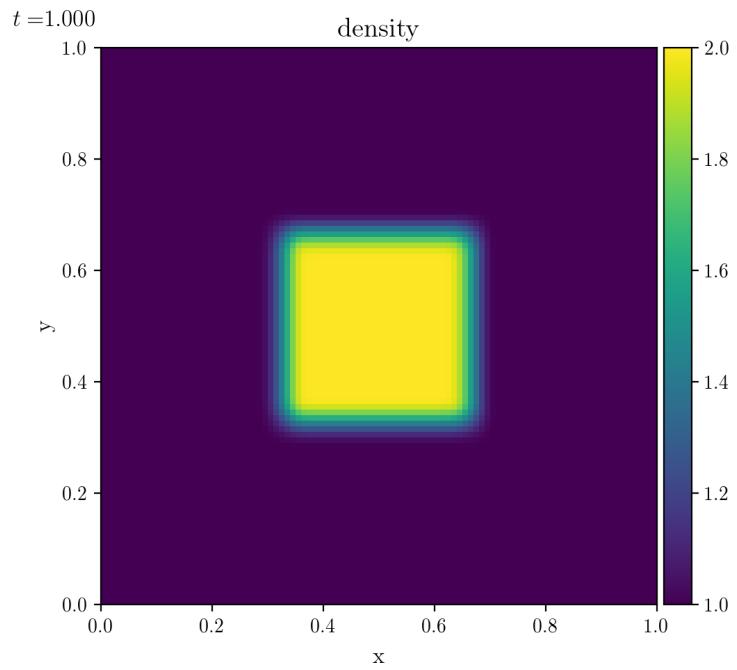


Figure 37: Monotonized central limiter. Expected result 2D

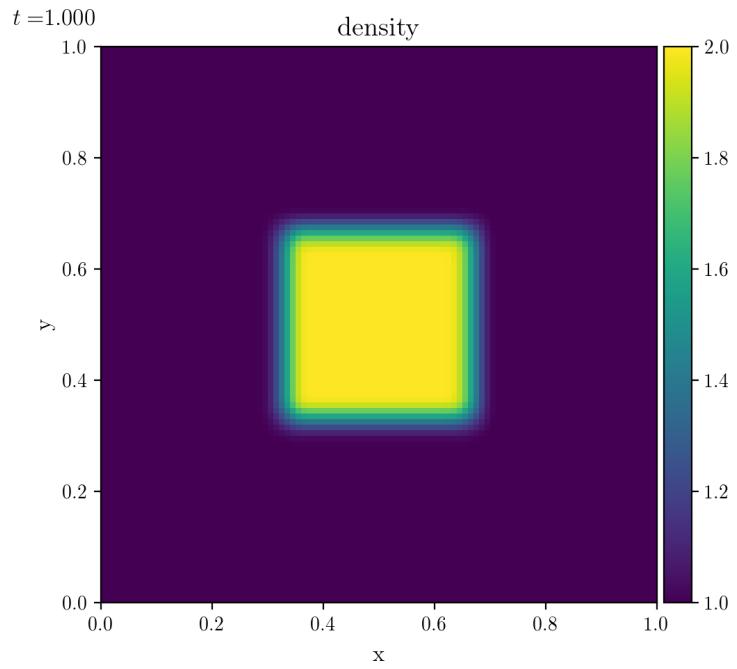


Figure 38: Monotonized central limiter. Obtained result 2D

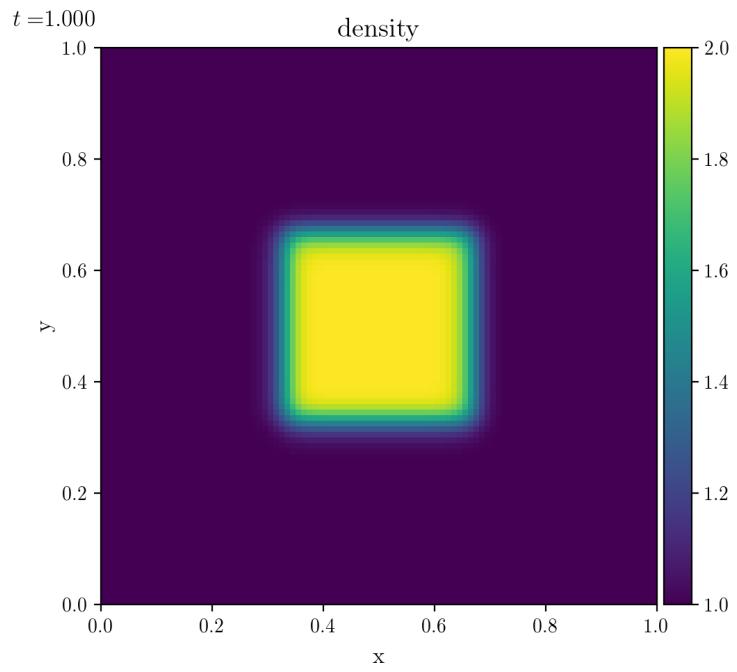


Figure 39: Van Leer Limiter. Expected result 2D

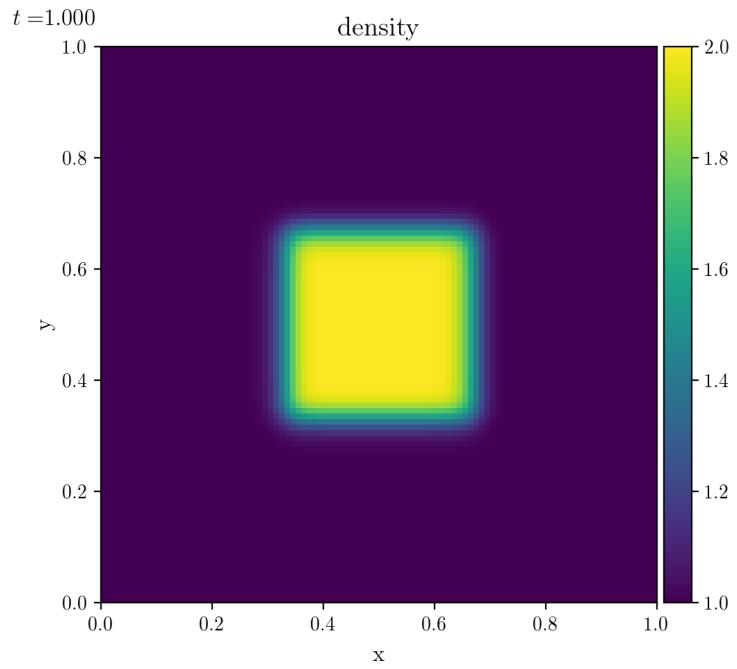


Figure 40: Van Leer Limiter. Obtained result 2D

1.4 WAF

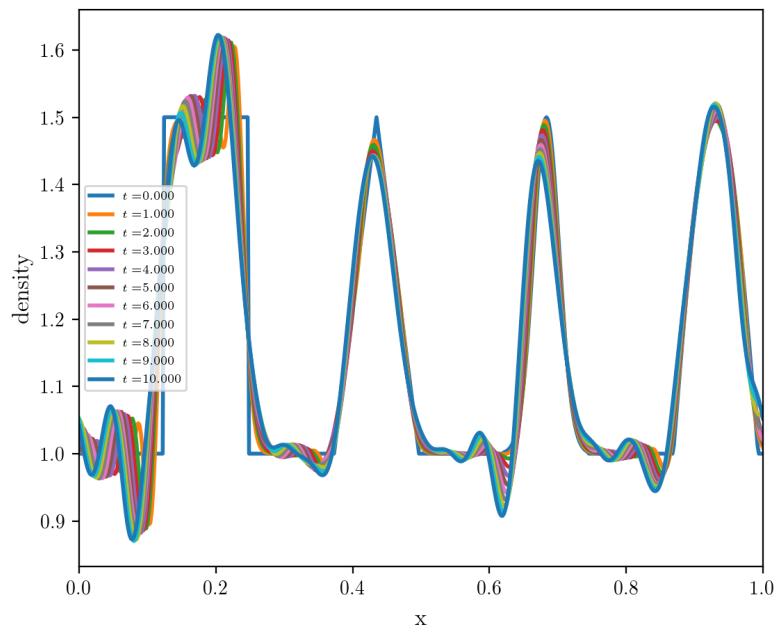


Figure 41: Expected result 1D

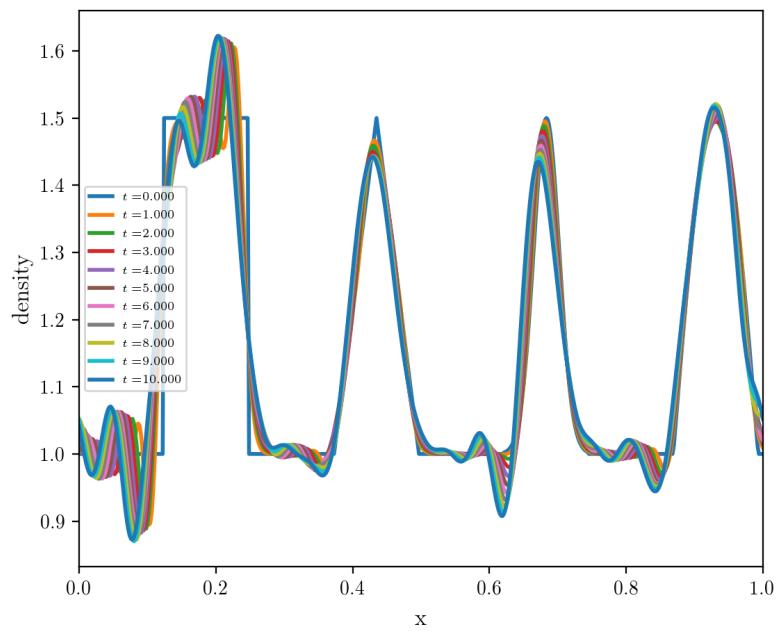


Figure 42: Obtained result 1D

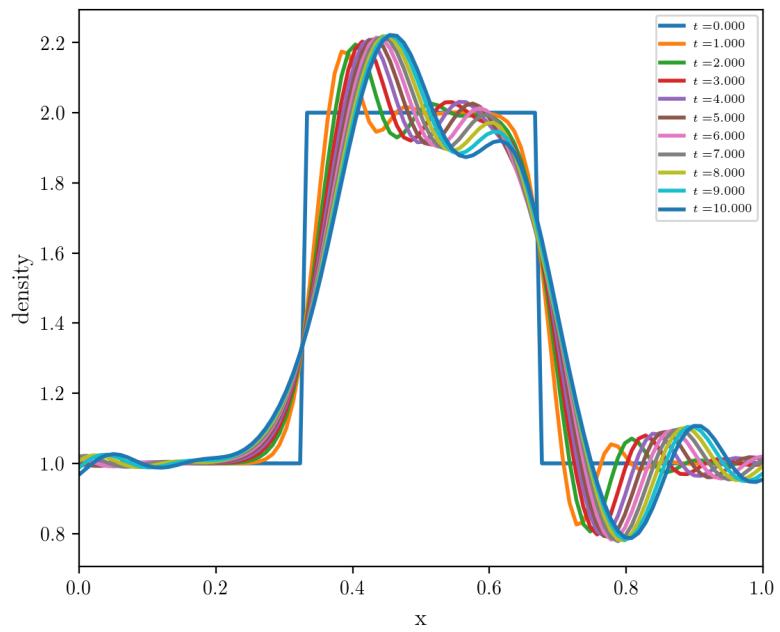


Figure 43: Expected result 1D negative velocity

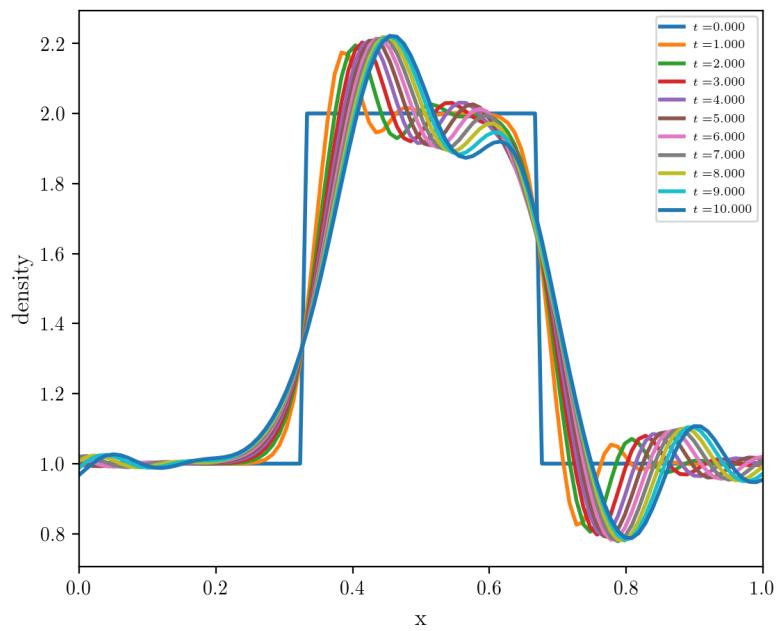


Figure 44: Obtained result 1D negative velocity

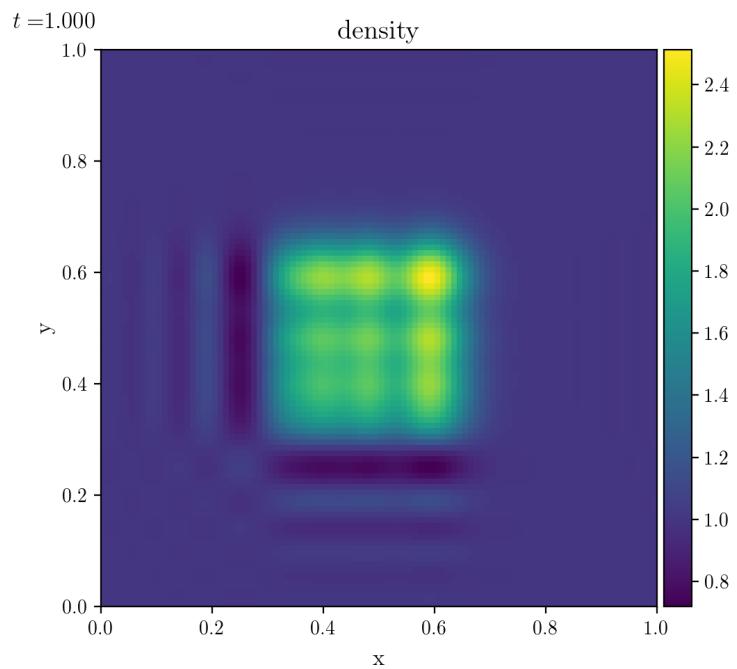


Figure 45: Expected result 2D

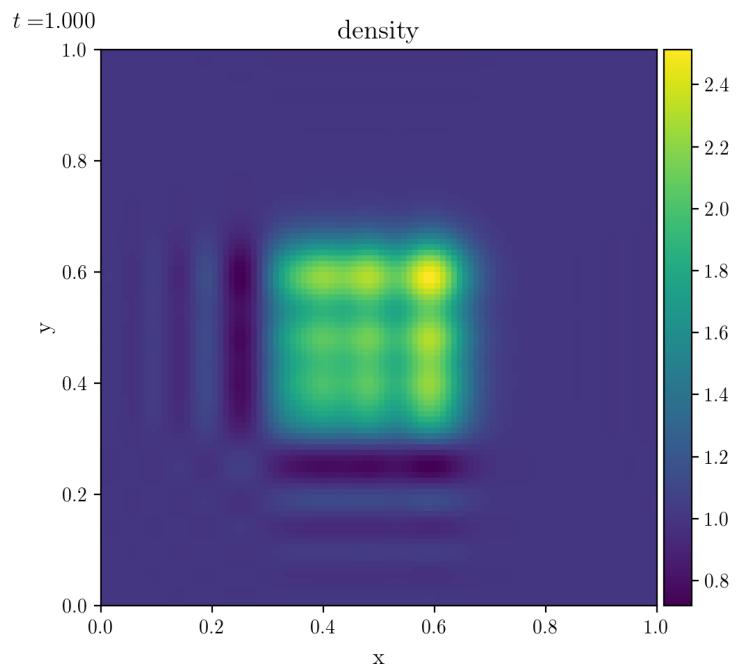


Figure 46: Obtained result 2D

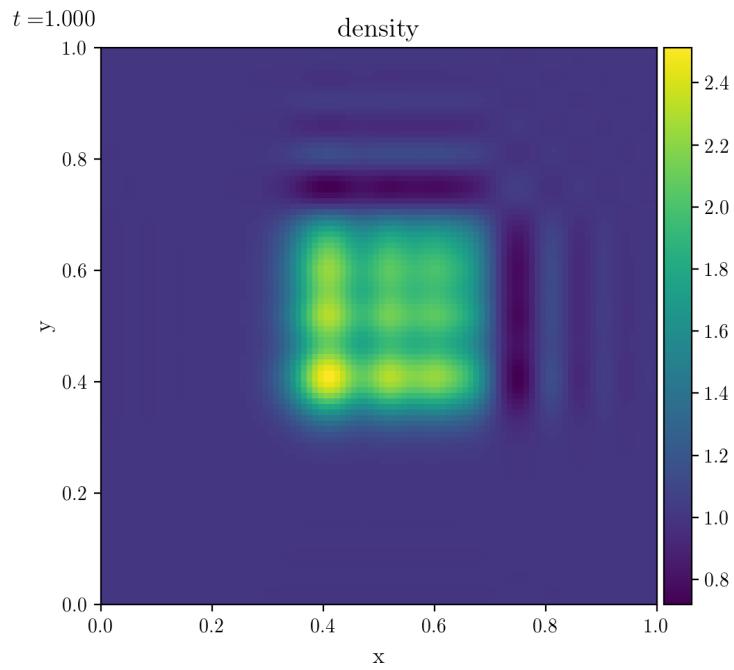


Figure 47: Expected result 2D negative velocity

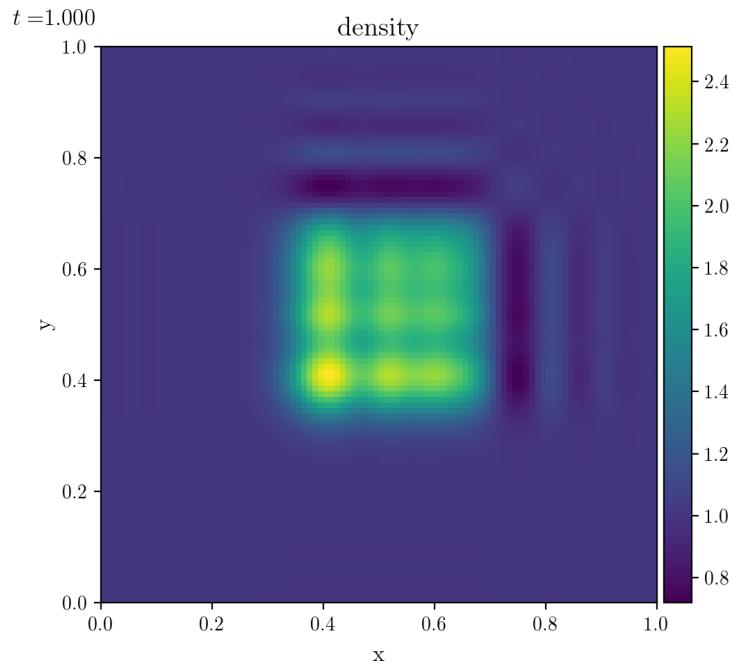


Figure 48: Obtained result 2D negative velocity

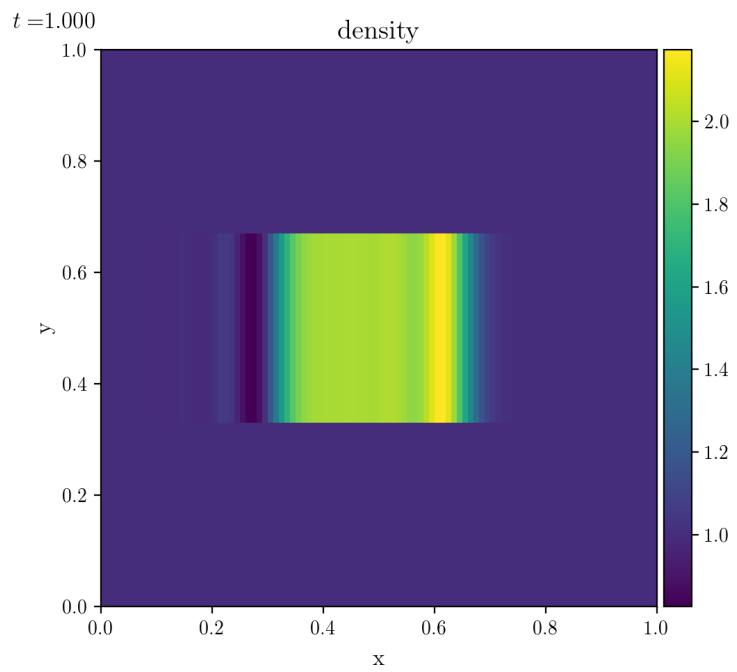


Figure 49: Expected result 2D velocity in x direction only

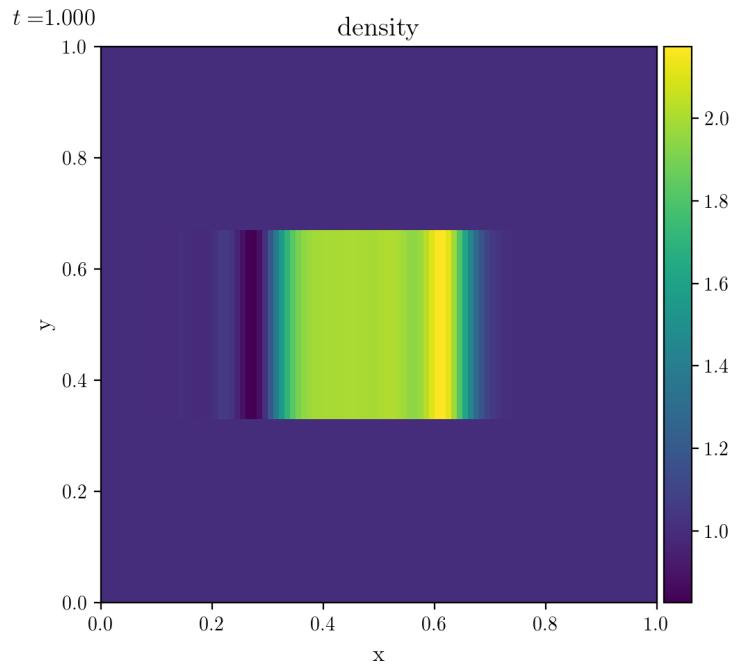


Figure 50: Obtained result 2D velocity in x direction only

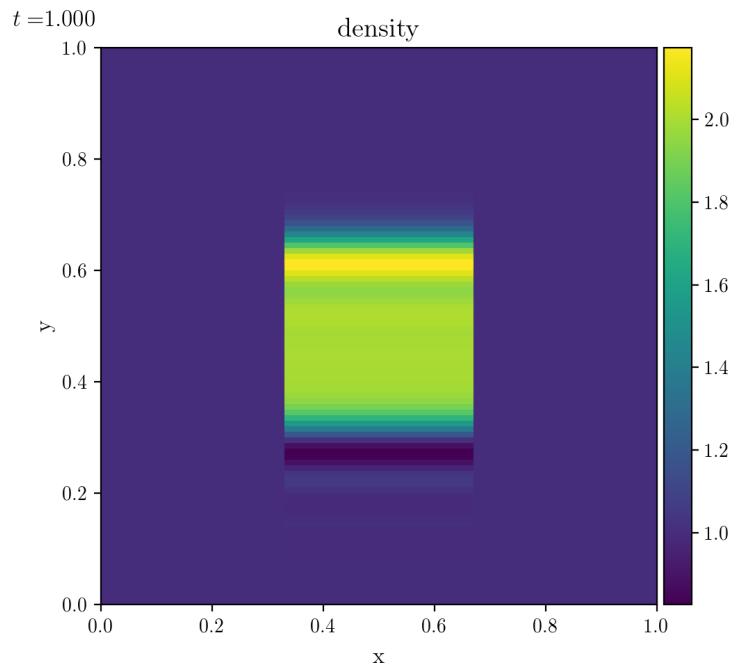


Figure 51: Expected result 2D velocity in y direction only

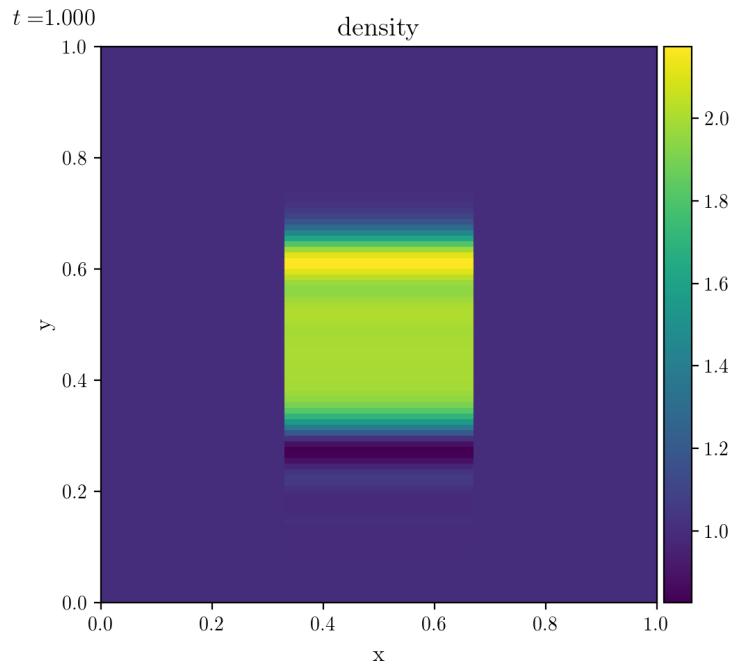


Figure 52: Obtained result 2D velocity in y direction only

1.5 WAF with Slope Limiters

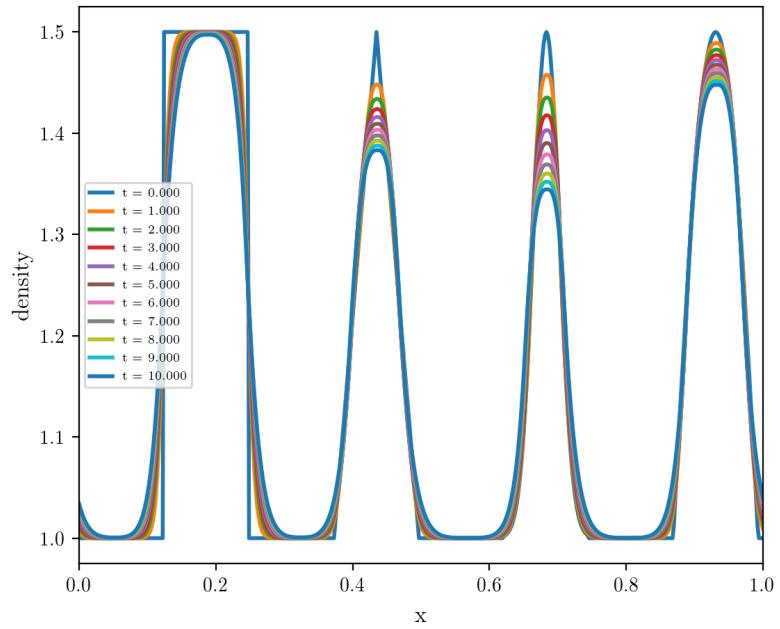


Figure 53: Minmod Slope Limiter. Expected result 1D

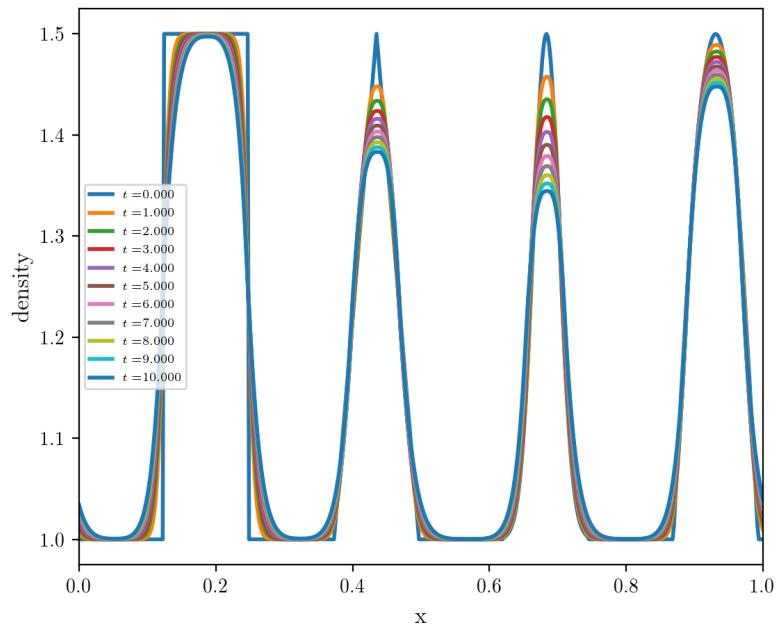


Figure 54: Minmod Slope Limiter. Obtained result 1D

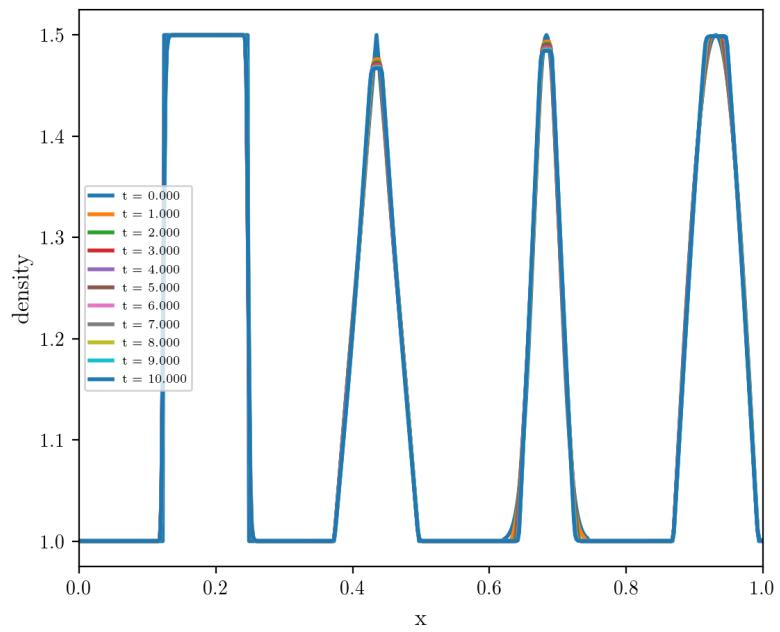


Figure 55: Superbee slope limiter. Expected result 1D negative velocity

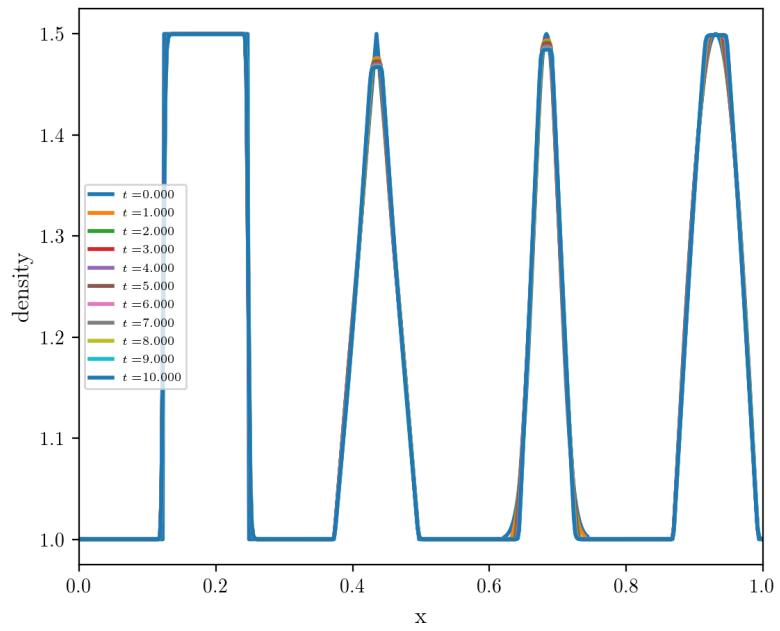


Figure 56: Superbee slope limiter. Obtained result 1D negative velocity

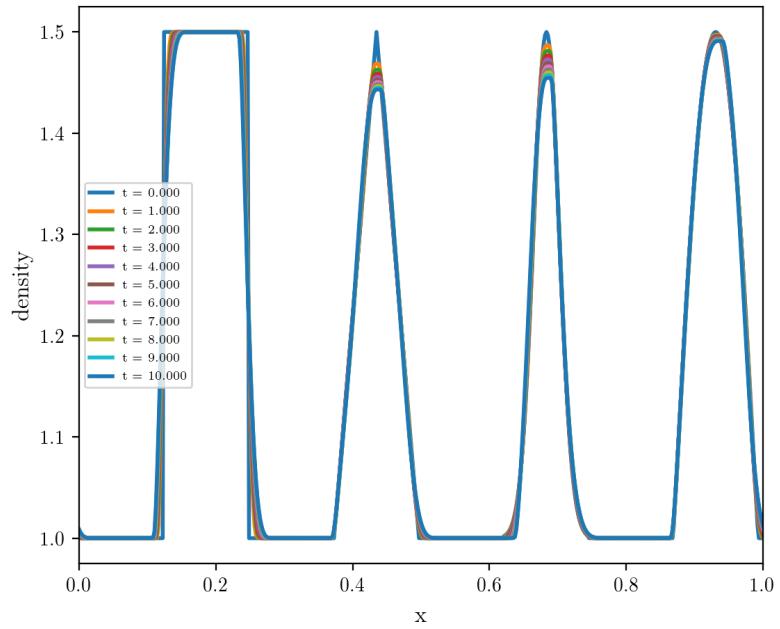


Figure 57: Monotonized central limiter. Expected result 1D

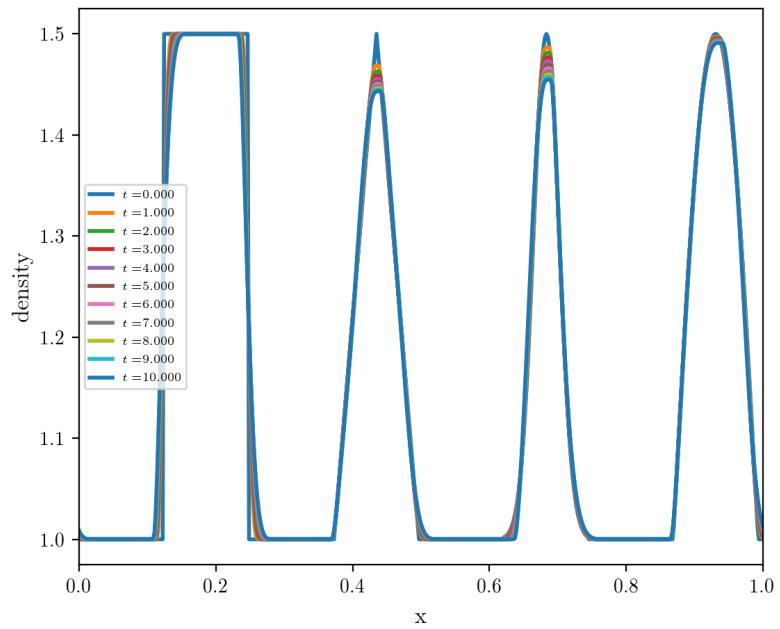


Figure 58: Monotonized central limiter. Obtained result 1D

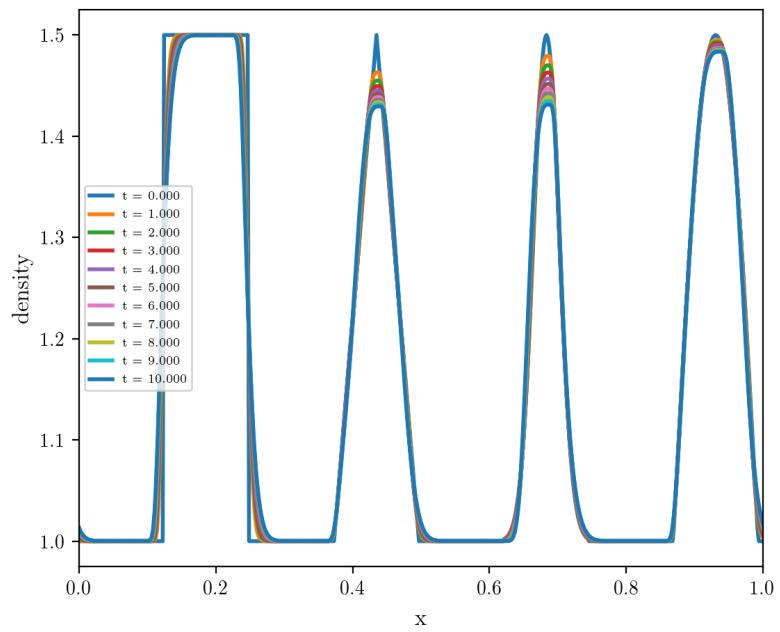


Figure 59: Van Leer Limiter. Expected result 1D

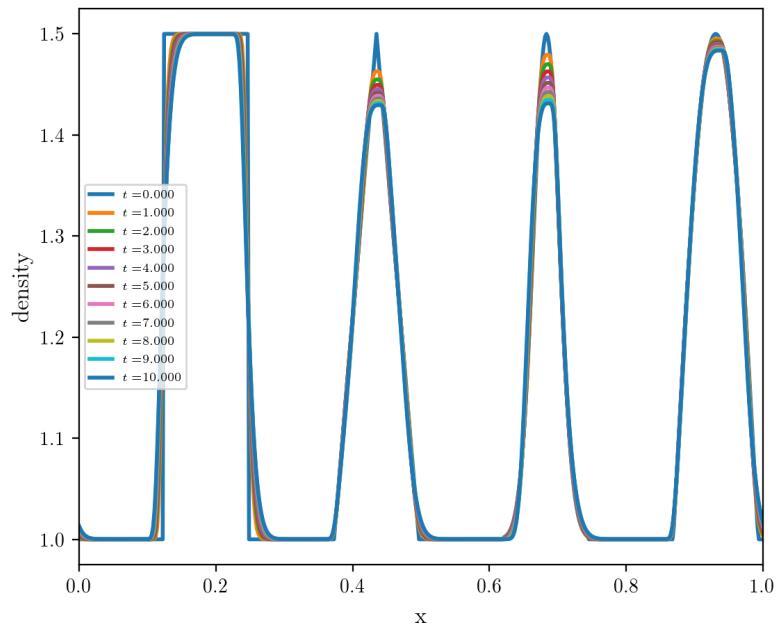


Figure 60: Van Leer Limiter. Obtained result 1D

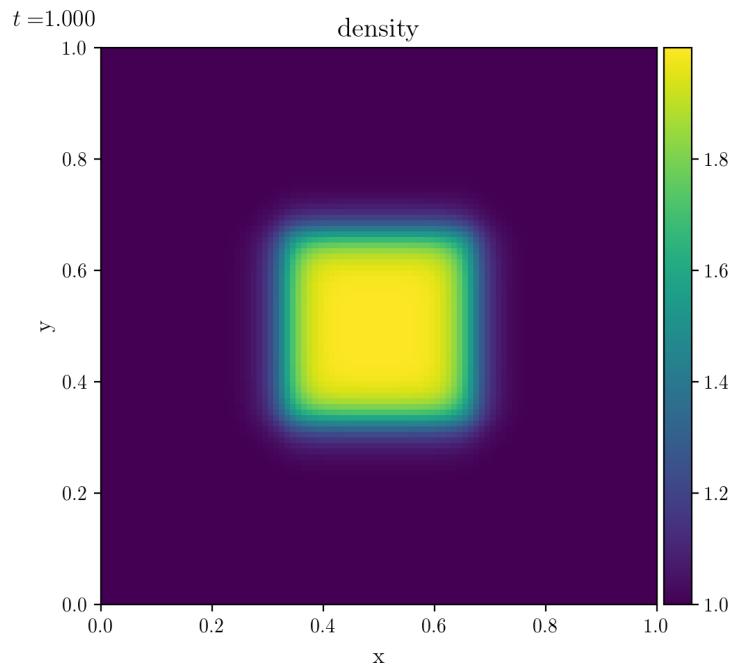


Figure 61: Minmod Slope Limiter. Expected result 2D

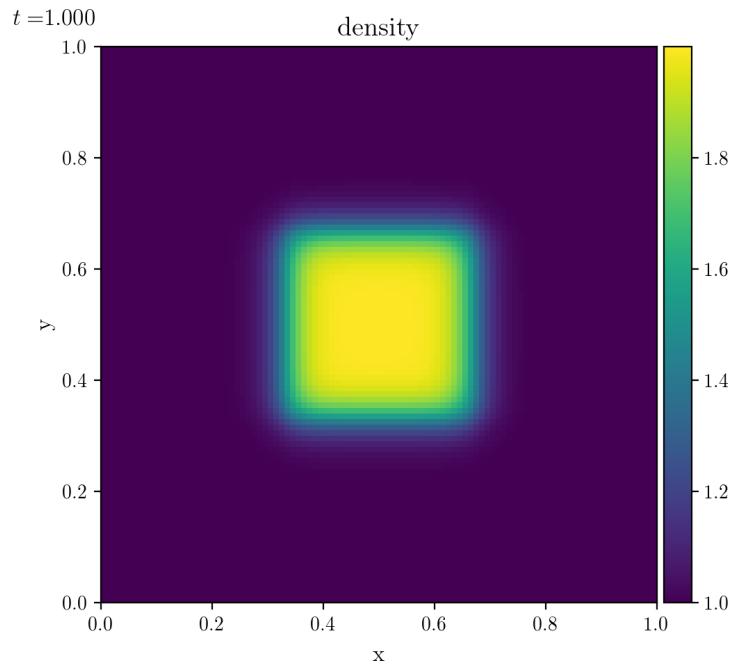


Figure 62: Minmod Slope Limiter. Obtained result 2D

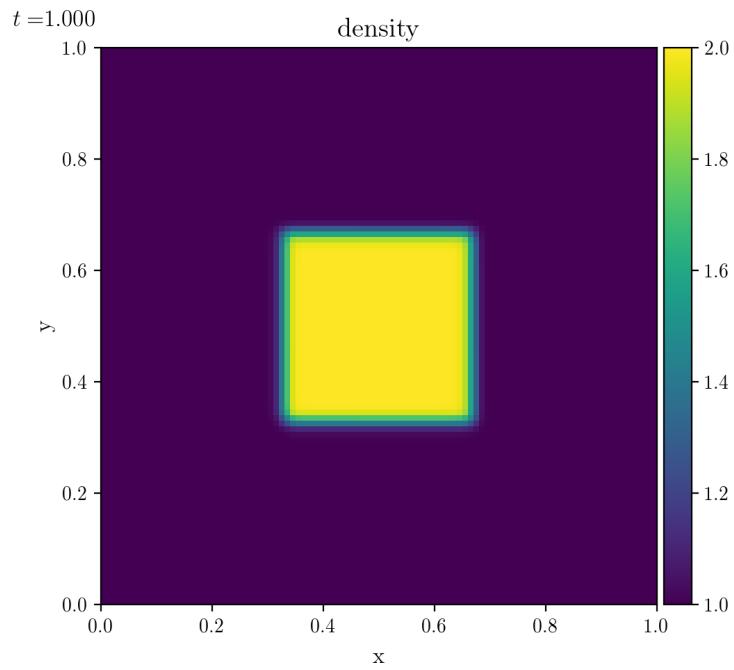


Figure 63: Superbee slope limiter. Expected result 2D negative velocity

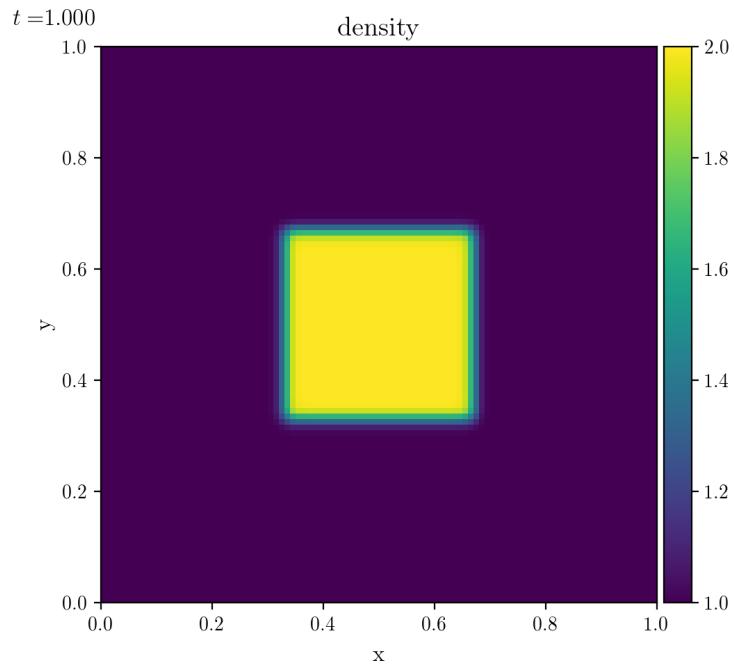


Figure 64: Superbee slope limiter. Obtained result 2D negative velocity

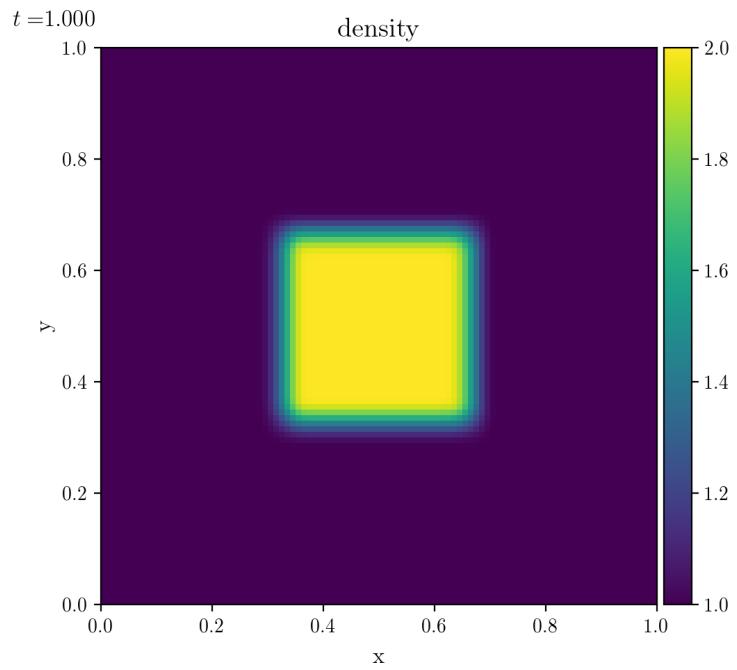


Figure 65: Monotonized central limiter. Expected result 2D

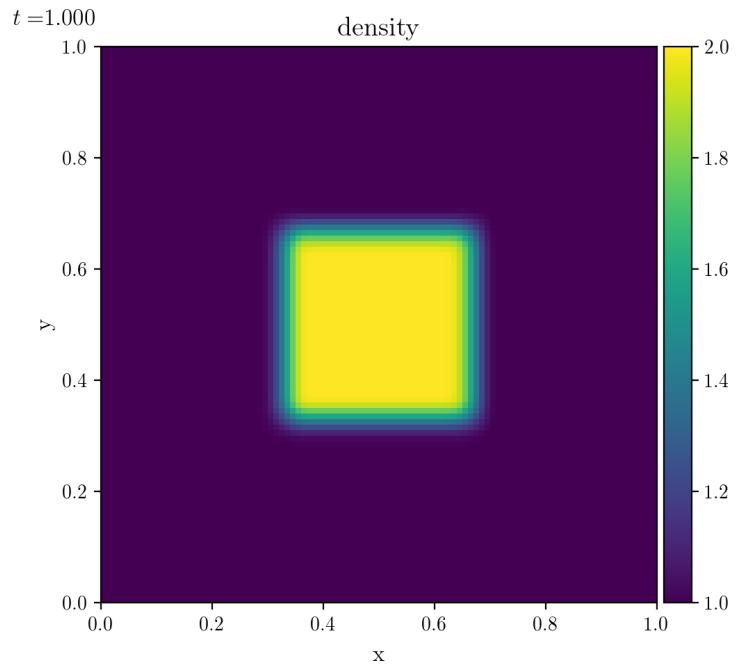


Figure 66: Monotonized central limiter. Obtained result 2D

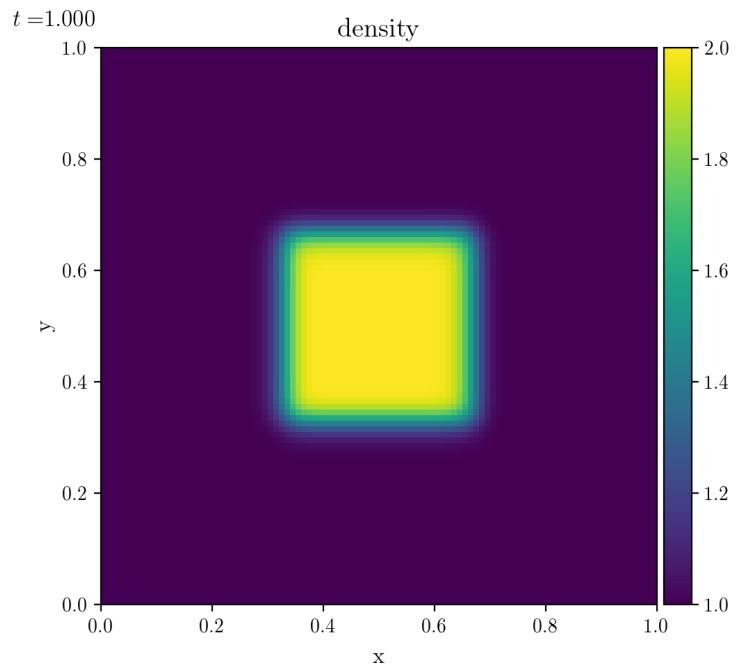


Figure 67: Van Leer Limiter. Expected result 2D

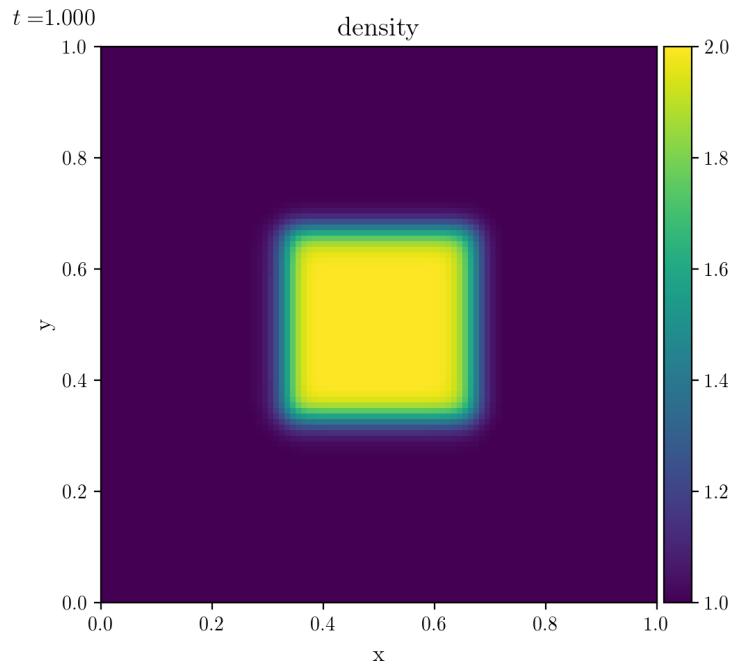


Figure 68: Van Leer Limiter. Obtained result 2D

2 Riemann Solvers

2.1 Exact vs Python

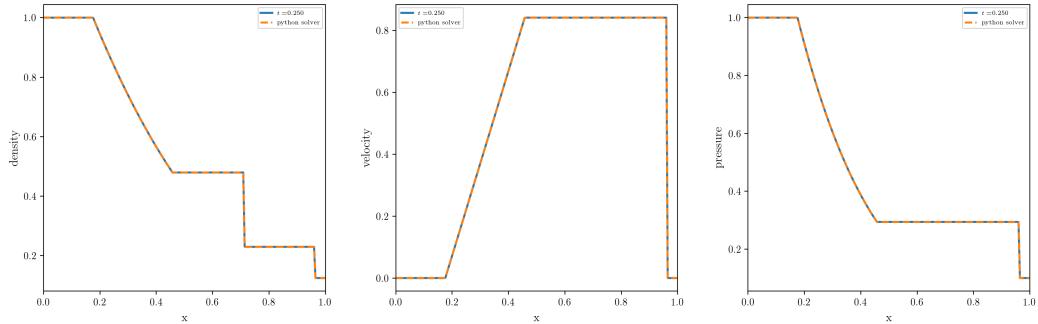


Figure 69: Exact solver for (right facing) sod shock. Expected result.

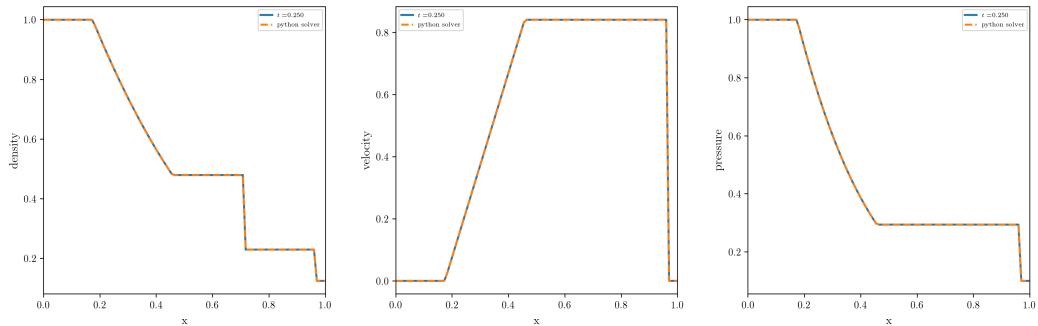


Figure 70: Exact solver for (right facing) sod shock. Obtained result.

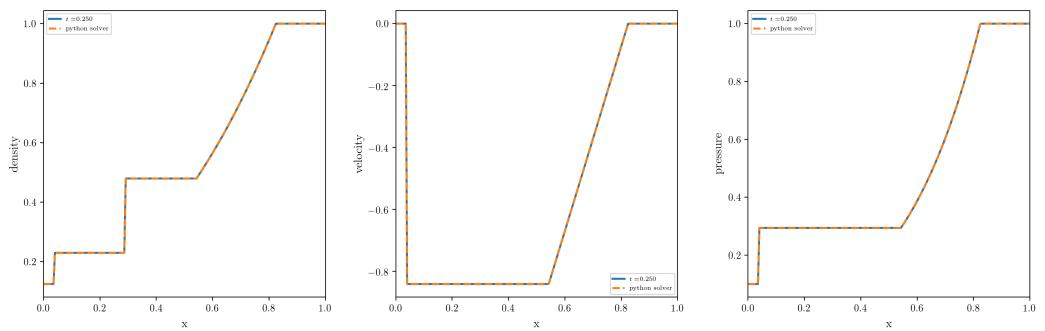


Figure 71: Exact solver for (left facing) sod shock. Expected result.

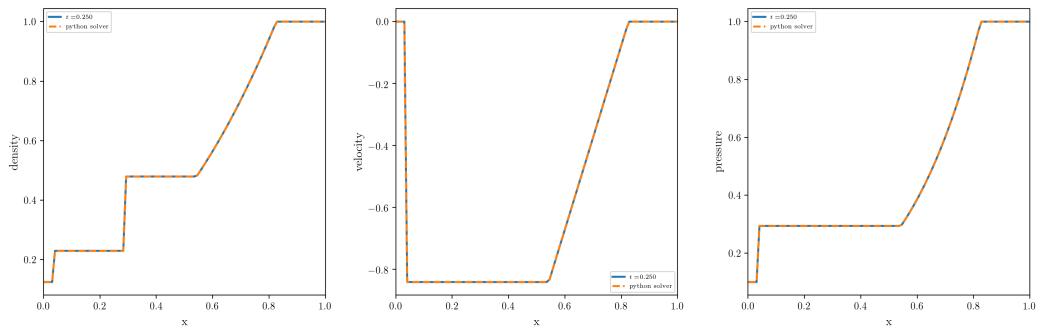


Figure 72: Exact solver for (left facing) sod shock. Obtained result.

2.2 Vacuum

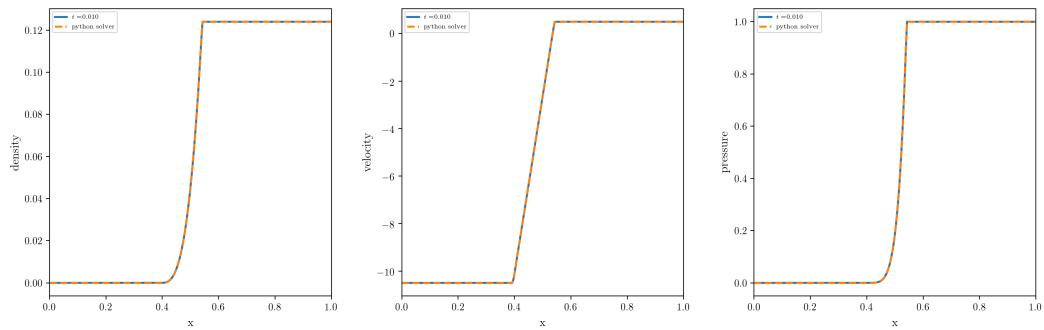


Figure 73: Exact solver for left vacuum state. Expected result.

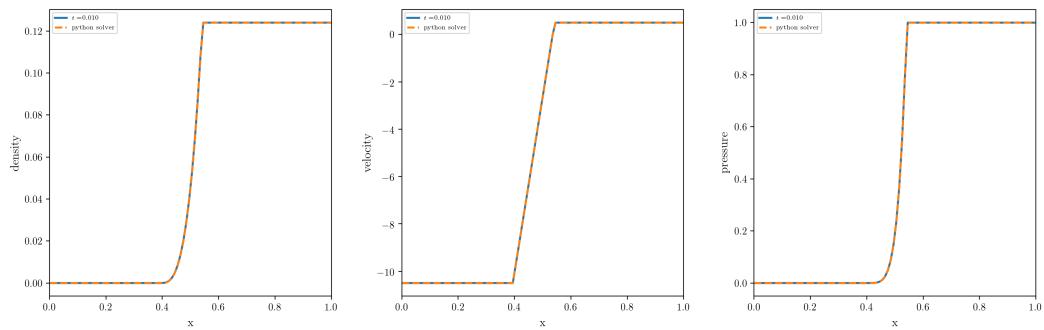


Figure 74: Exact solver for left vacuum state. Obtained result.

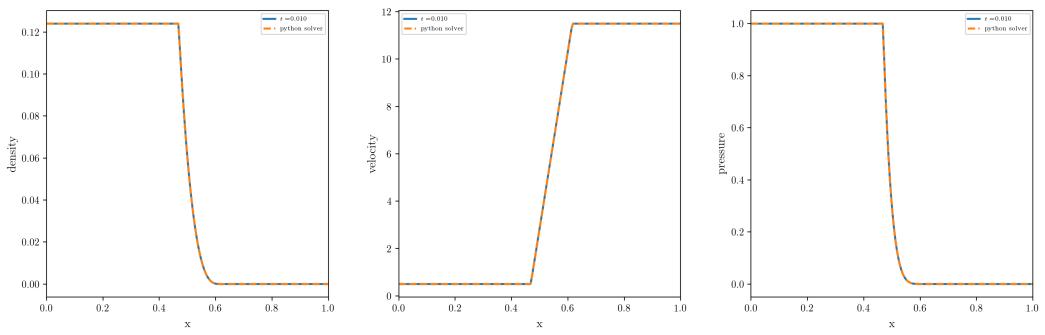


Figure 75: Exact solver for left vacuum state. Expected result.

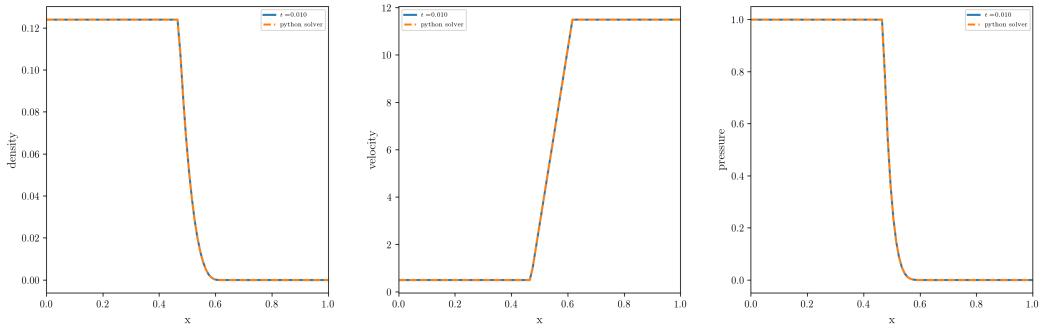


Figure 76: Exact solver for left vacuum state. Obtained result.

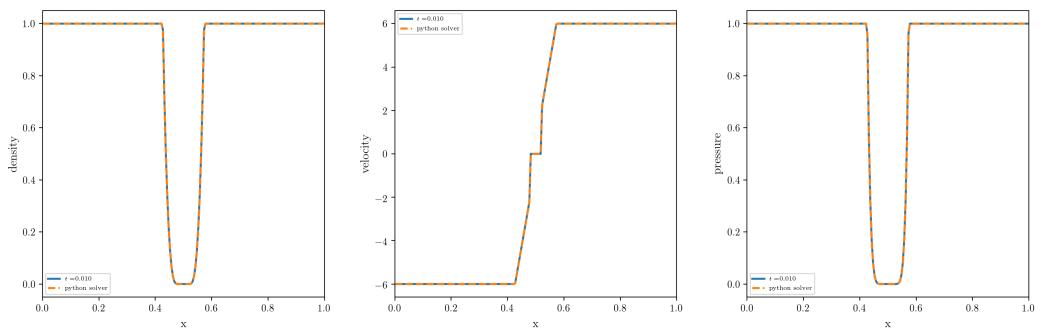


Figure 77: Exact solver for vacuum generating conditions. Expected result.

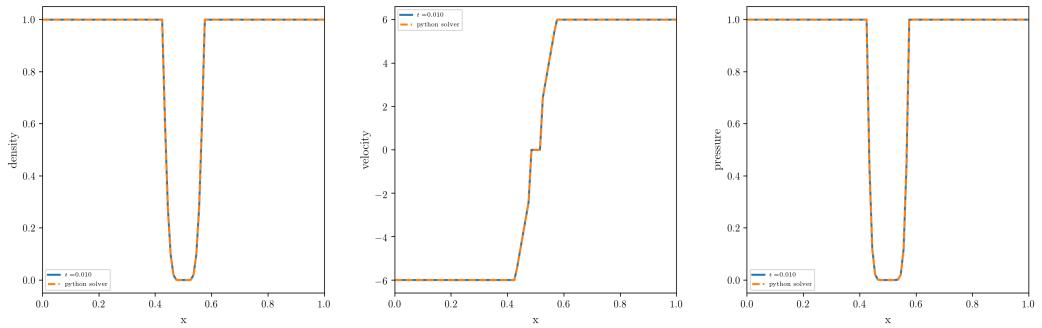


Figure 78: Exact solver for vacuum generating conditions. Obtained result.

3 Godunov's Method

3.1 1D with different Riemann Solvers

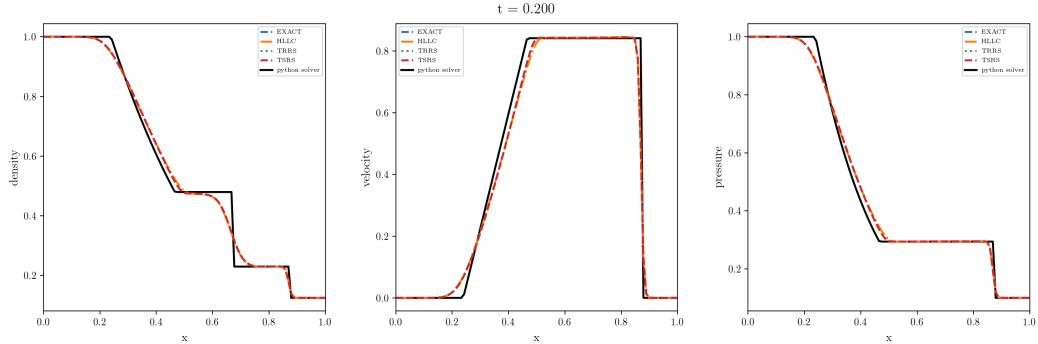


Figure 79: Godunov's method for (right facing) sod shock. Expected result.

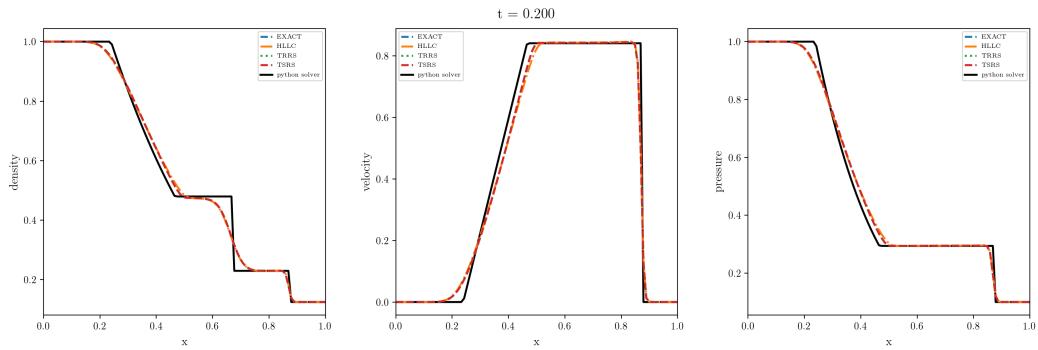


Figure 80: Godunov's method for (right facing) sod shock. Obtained result.

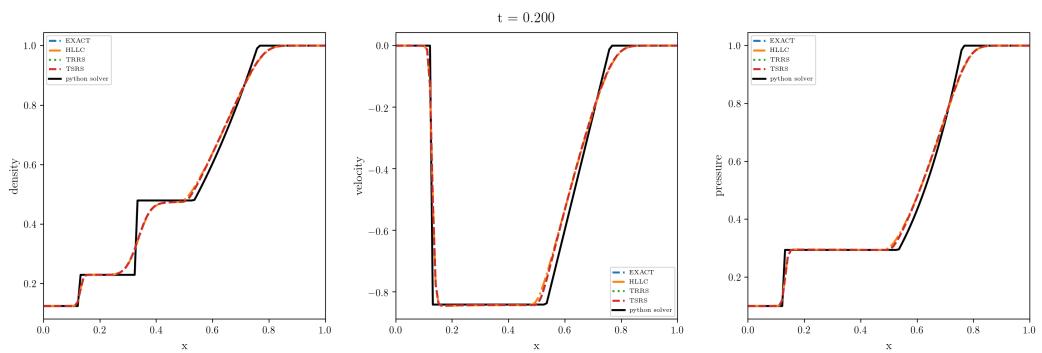


Figure 81: Godunov's method for (left facing) sod shock. Expected result.

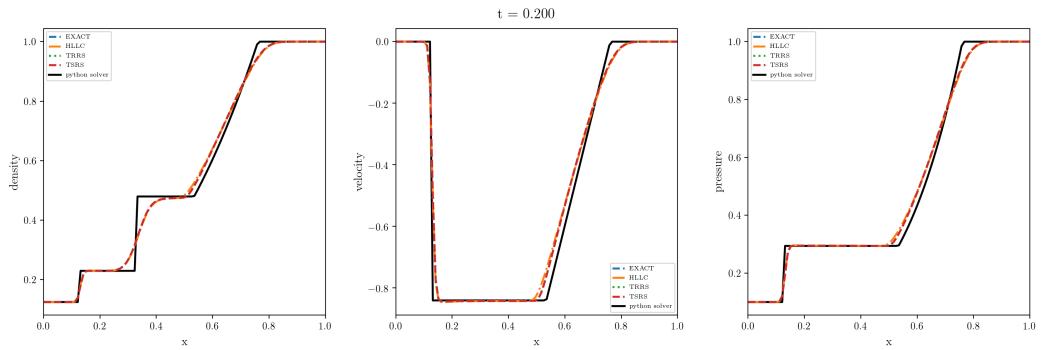


Figure 82: Godunov's method for (left facing) sod shock. Obtained result.

3.2 Vacuum in 1D

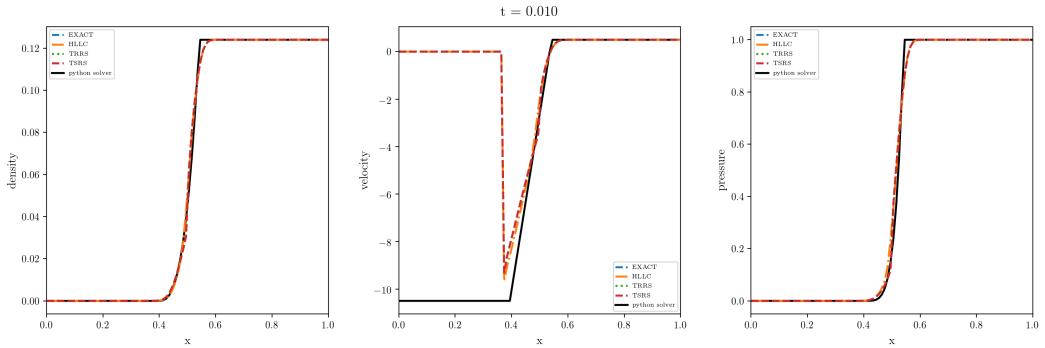


Figure 83: Godunov's method for left vacuum state. Expected result.

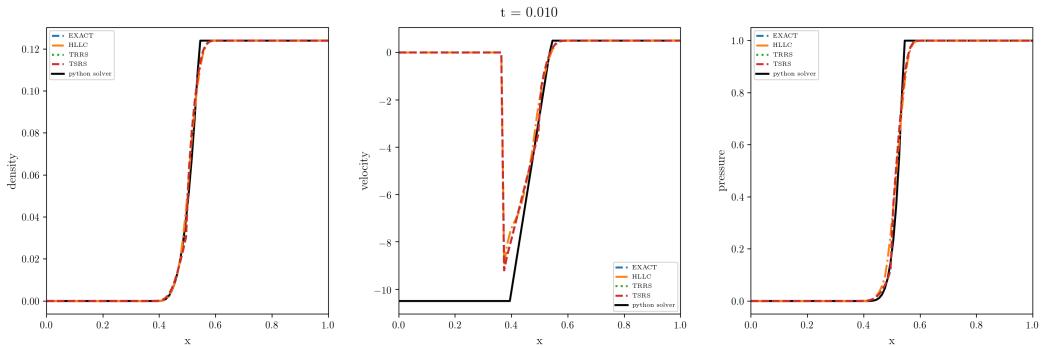


Figure 84: Godunov's method for left vacuum state. Obtained result.

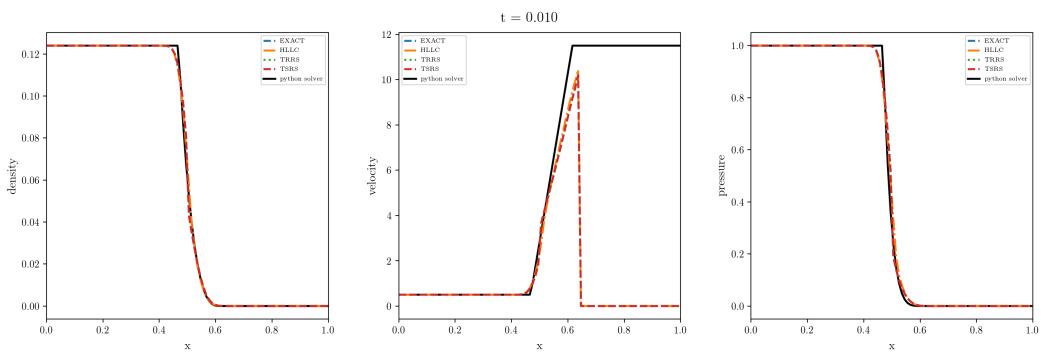


Figure 85: Godunov's method for left vacuum state. Expected result.

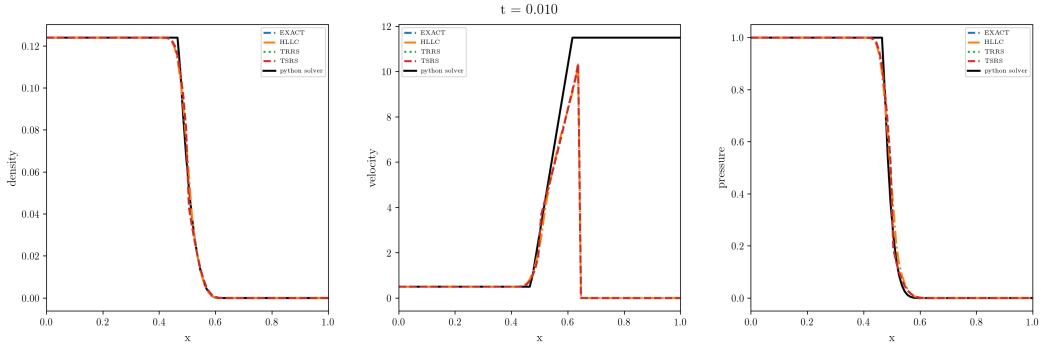


Figure 86: Godunov's method for left vacuum state. Obtained result.

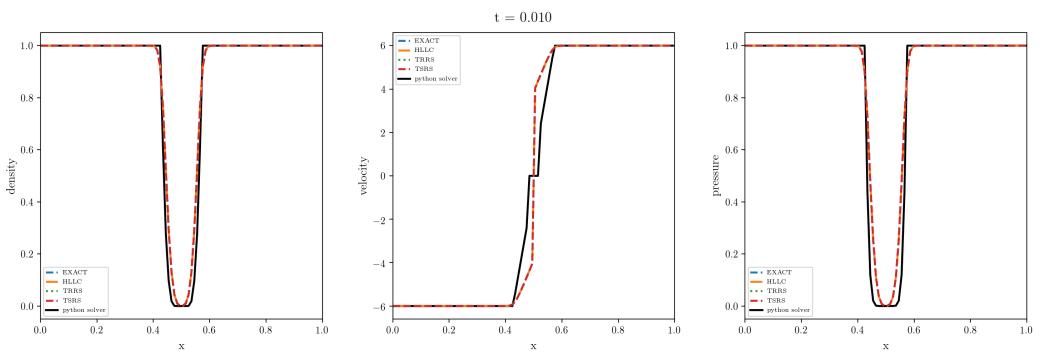


Figure 87: Godunov's method for vacuum generating conditions. Expected result.

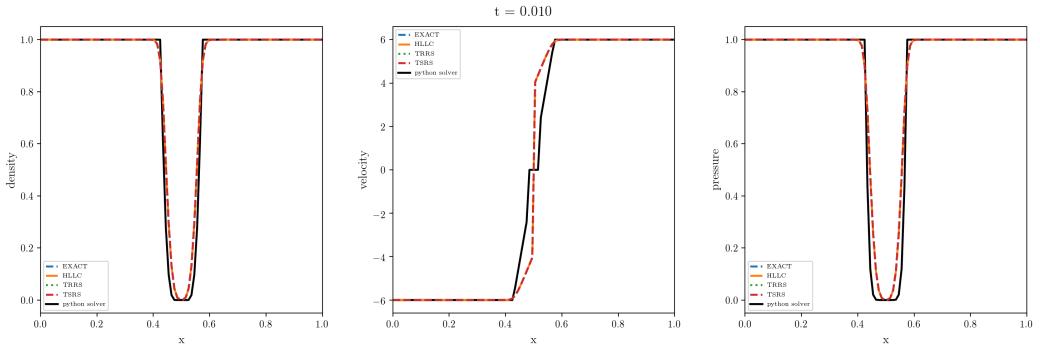


Figure 88: Godunov's method for vacuum generating conditions. Obtained result.

3.3 2D with different Riemann Solvers

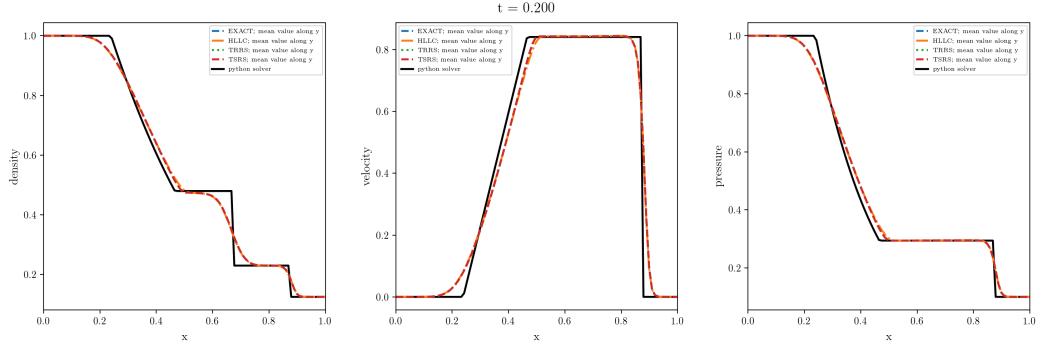


Figure 89: Godunov's method for (right facing) sod shock. Expected result.

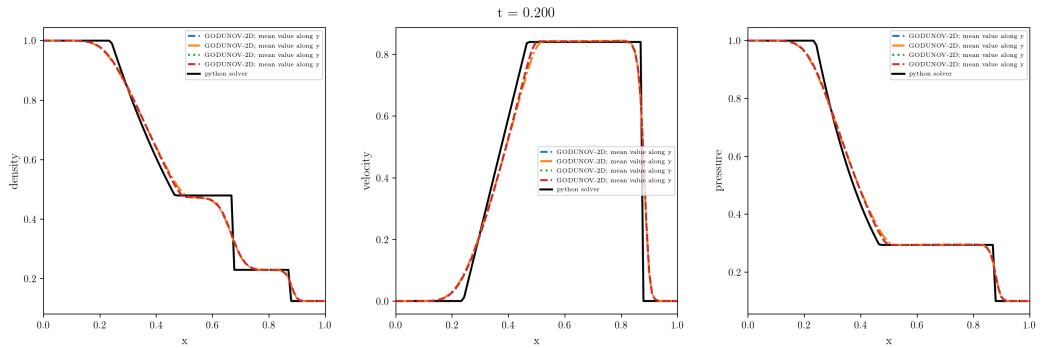


Figure 90: Godunov's method for (right facing) sod shock. Obtained result.

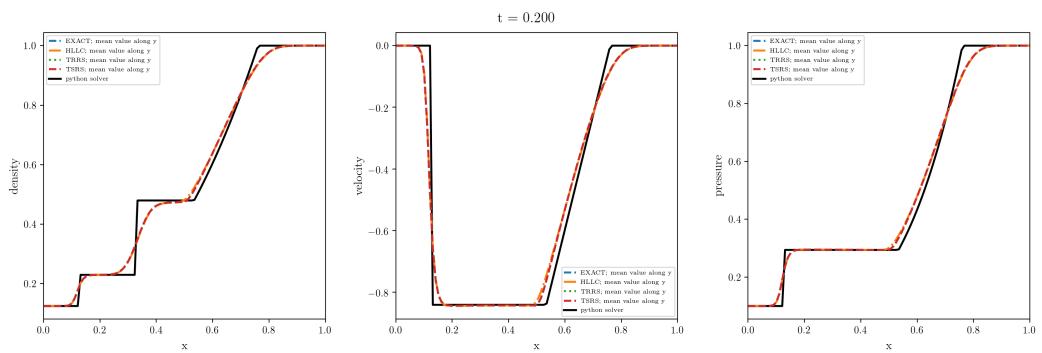


Figure 91: Godunov's method for (left facing) sod shock. Expected result.

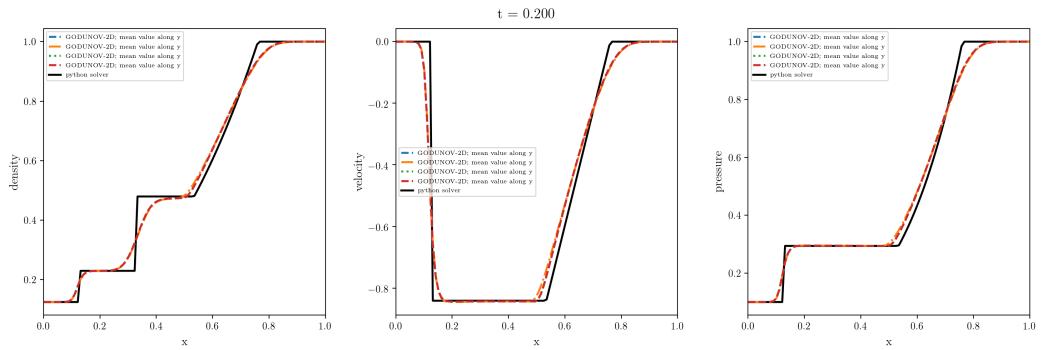


Figure 92: Godunov's method for (left facing) sod shock. Obtained result.

3.4 Vacuum in 2D

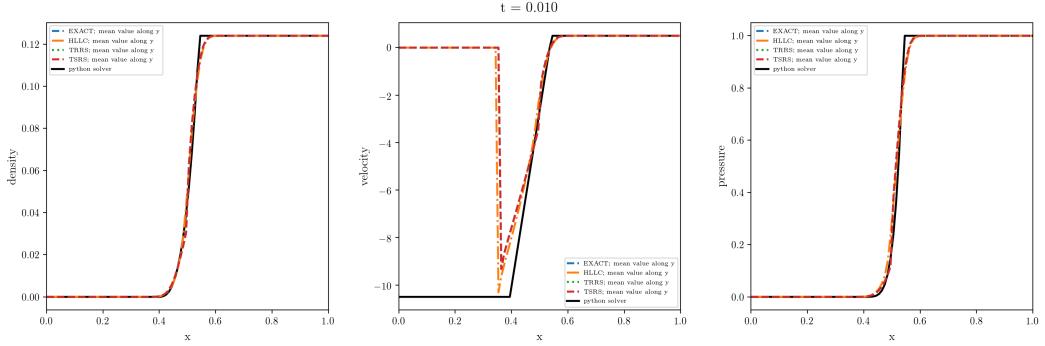


Figure 93: Godunov's method for left vacuum state. Expected result.

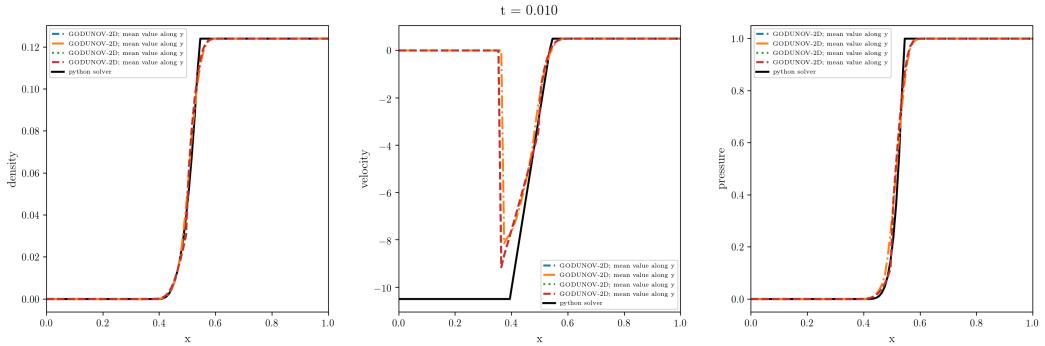


Figure 94: Godunov's method for left vacuum state. Obtained result.

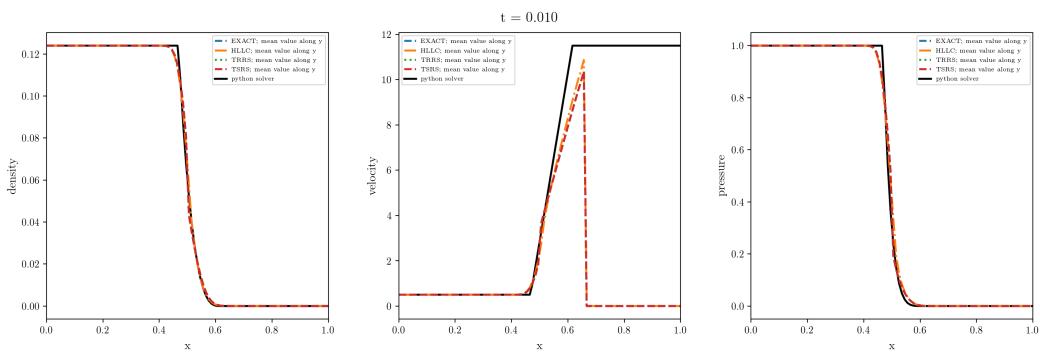


Figure 95: Godunov's method for left vacuum state. Expected result.

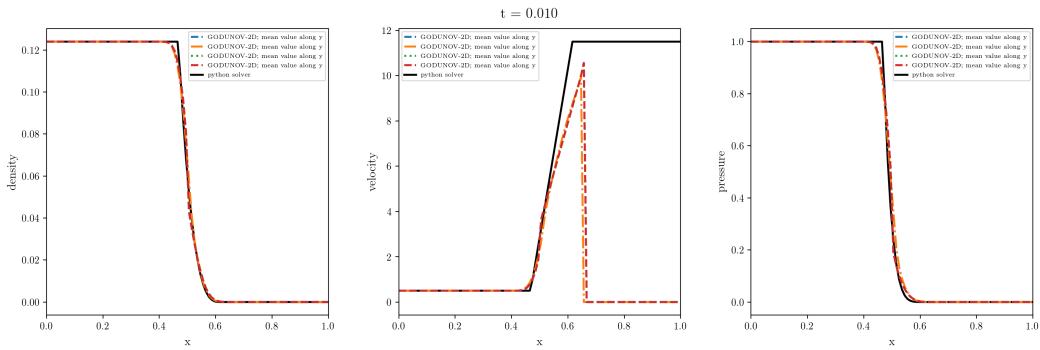


Figure 96: Godunov's method for left vacuum state. Obtained result.

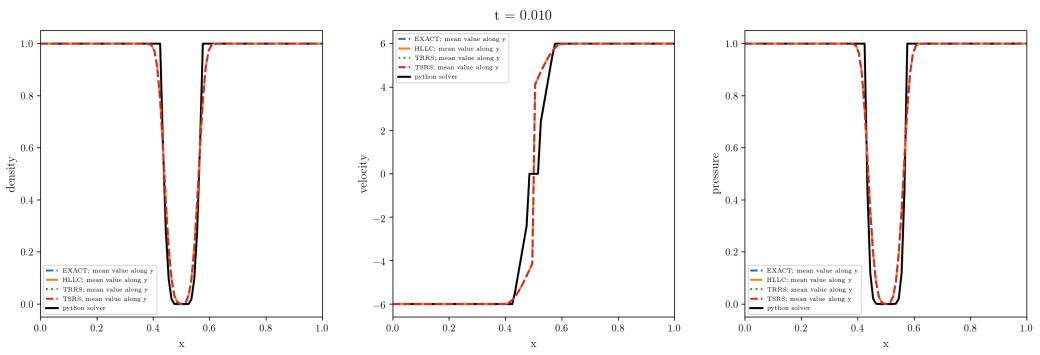


Figure 97: Godunov's method for vacuum generating conditions. Expected result.

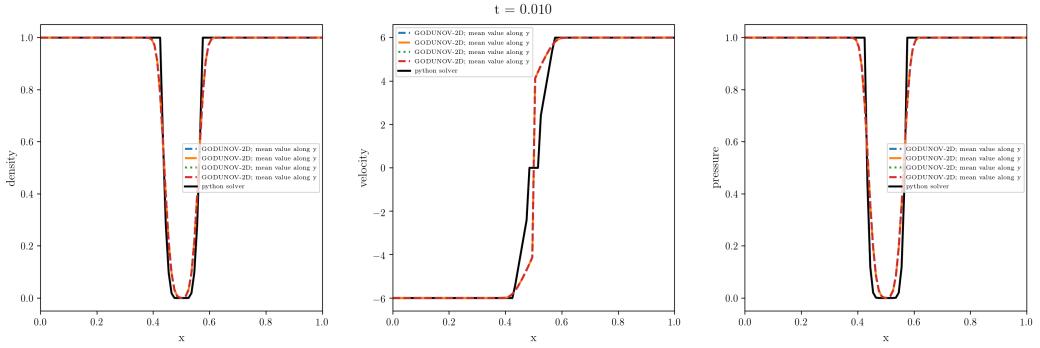


Figure 98: Godunov's method for vacuum generating conditions. Obtained result.

3.5 Others in 2D

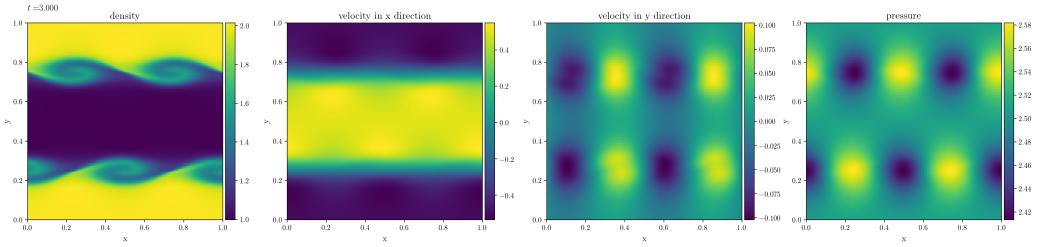


Figure 99: Godunov's method for Kelvin Helmholtz instability. Expected result.

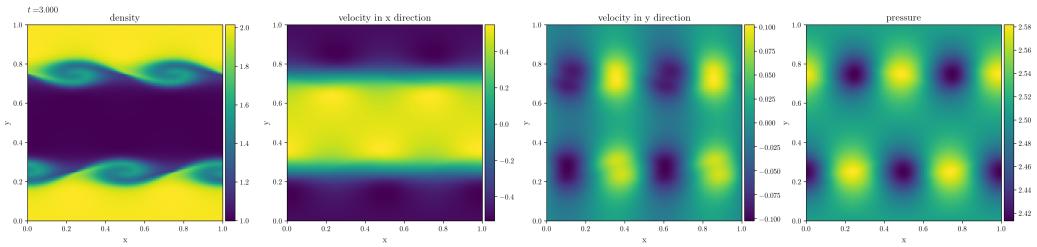


Figure 100: Godunov's method for Kelvin Helmholtz instability. Obtained result.

4 WAF Method

4.1 1D with different Limiters

4.1.1 Without limiter

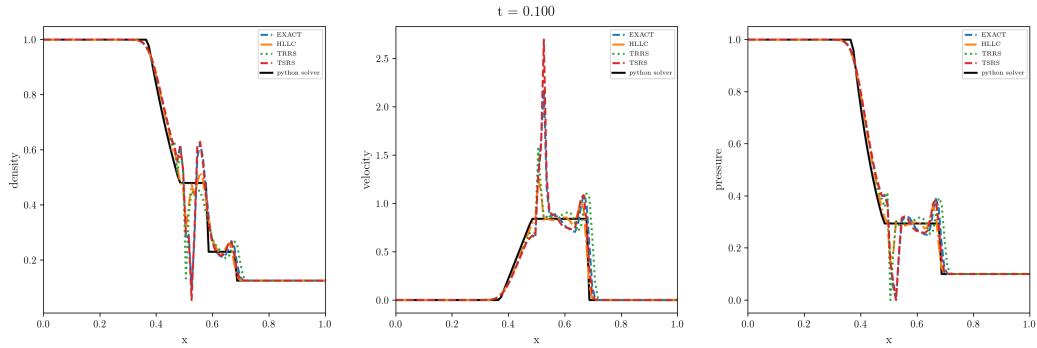


Figure 101: WAF method for (right facing) sod shock, no flux limiter. Expected result.

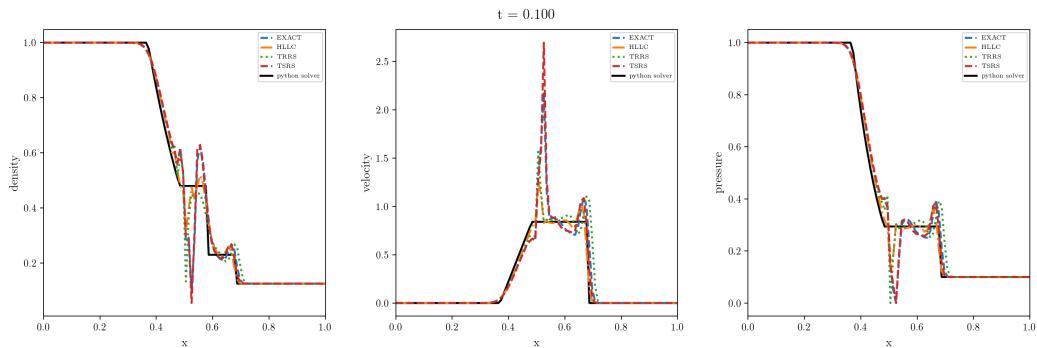


Figure 102: WAF method for (right facing) sod shock, no flux limiter. Obtained result.

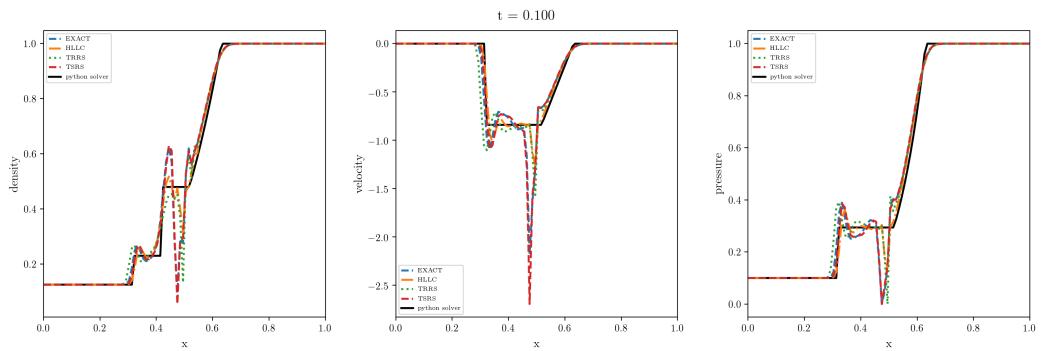


Figure 103: WAF method for (left facing) sod shock, no flux limiter. Expected result.

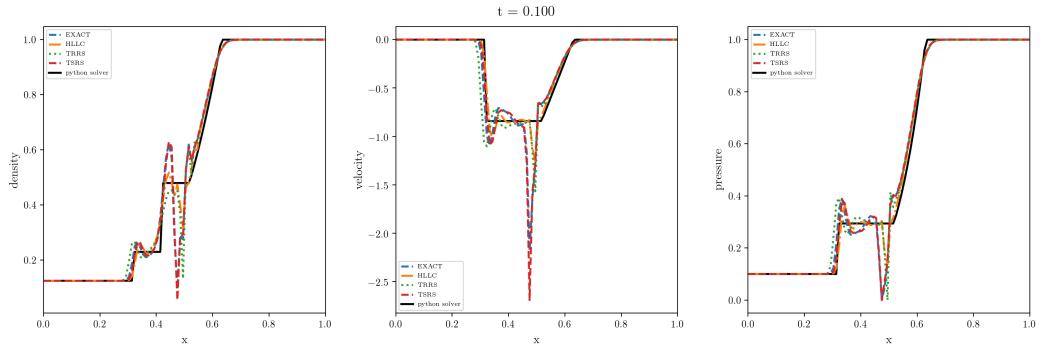


Figure 104: WAF method for (left facing) sod shock, no flux limiter. Obtained result.

4.1.2 MC limiter

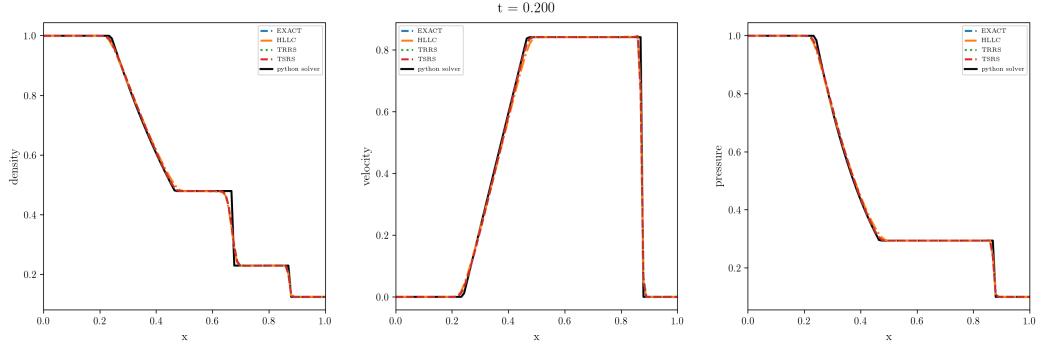


Figure 105: WAF method for (right facing) sod shock, MC flux limiter. Expected result.

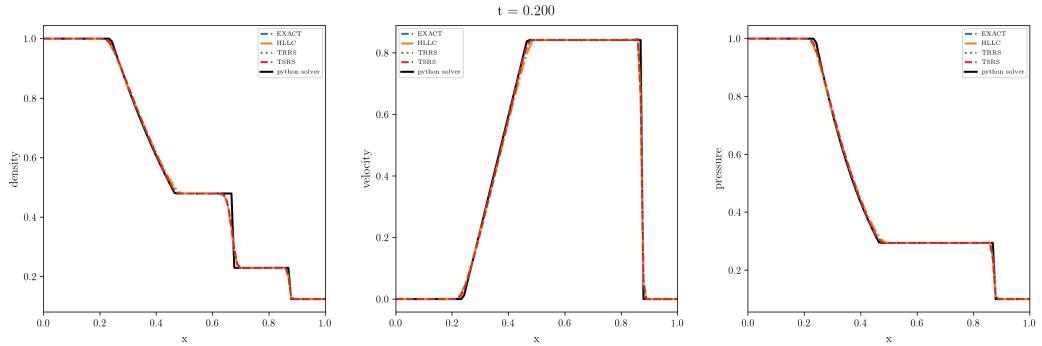


Figure 106: WAF method for (right facing) sod shock, MC flux limiter. Obtained result.

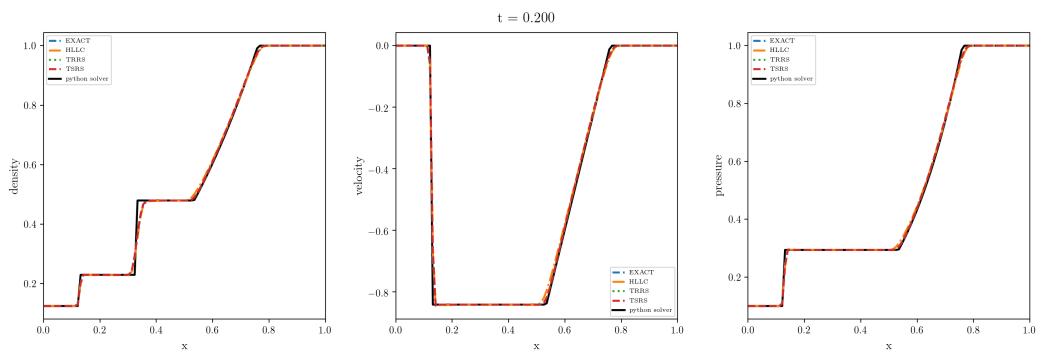


Figure 107: WAF method for (left facing) sod shock, MC flux limiter. Expected result.

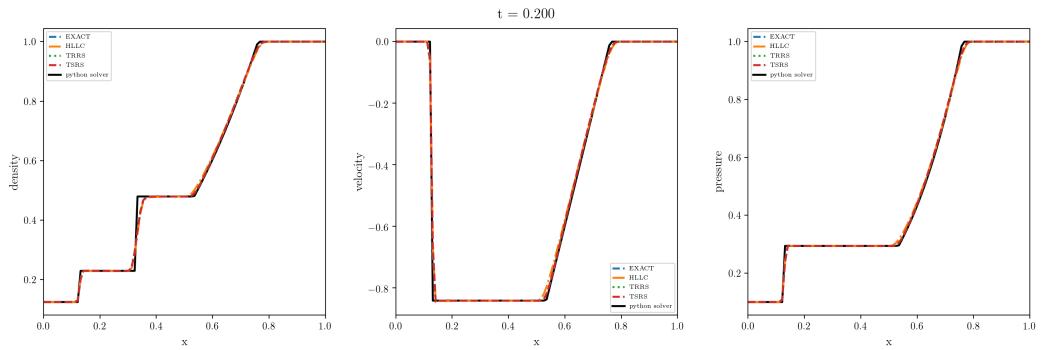


Figure 108: WAF method for (left facing) sod shock, MC flux limiter. Obtained result.

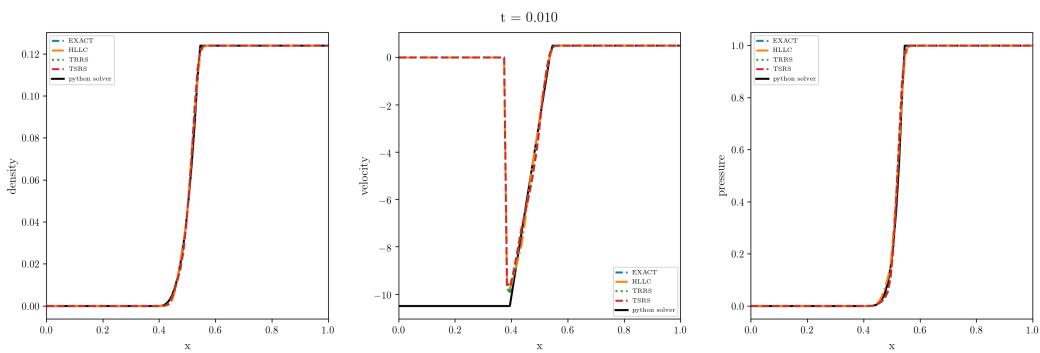


Figure 109: WAF method for left vacuum state, MC flux limiter. Expected result.

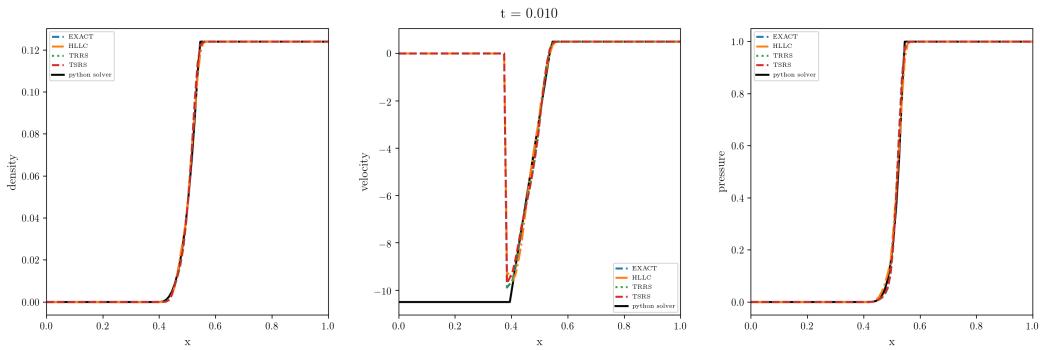


Figure 110: WAF method for left vacuum state, MC flux limiter. Obtained result.

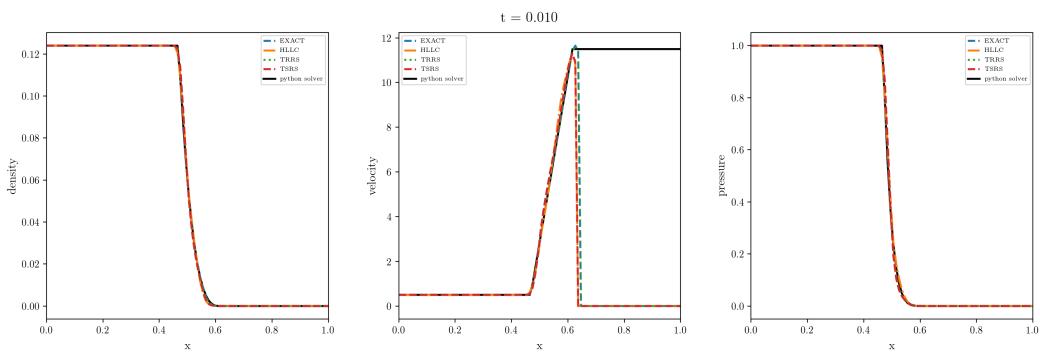


Figure 111: WAF method for left vacuum state, MC flux limiter. Expected result.

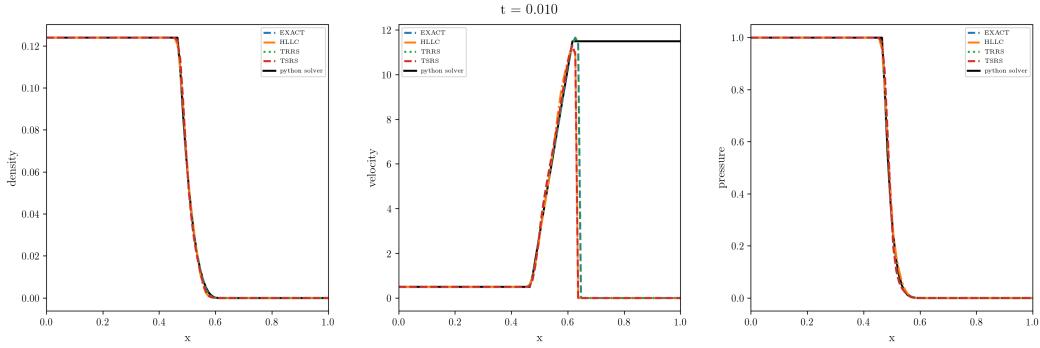


Figure 112: WAF method for left vacuum state, MC flux limiter. Obtained result.

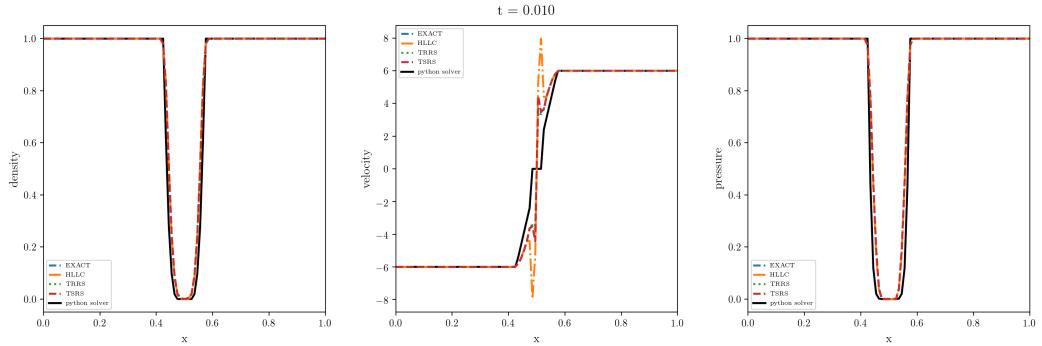


Figure 113: WAF method for vacuum generating conditions, MC flux limiter. Expected result.

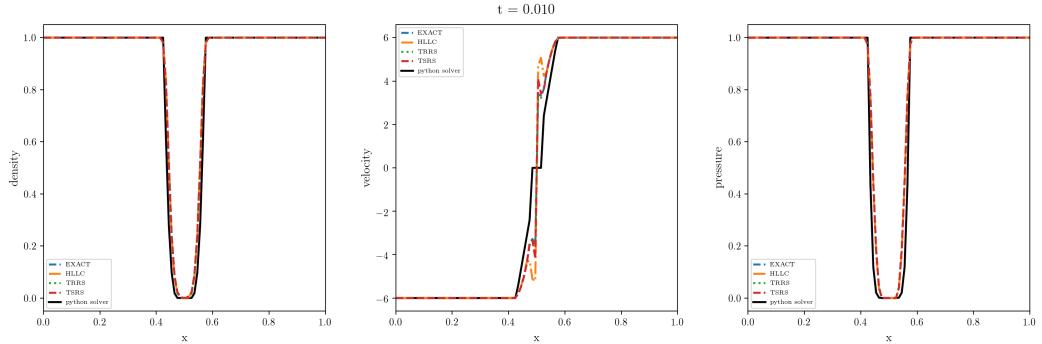


Figure 114: WAF method for vacuum generating conditions, MC flux limiter. Obtained result.

4.1.3 MINMOD limiter

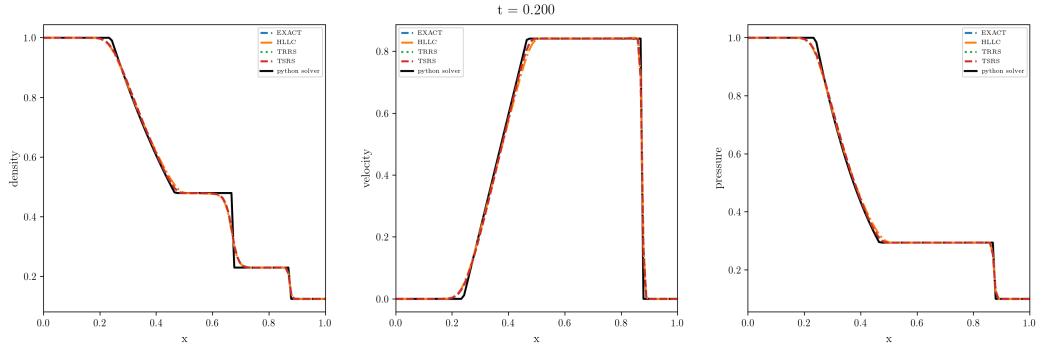


Figure 115: WAF method for (right facing) sod shock, MINMOD flux limiter. Expected result.

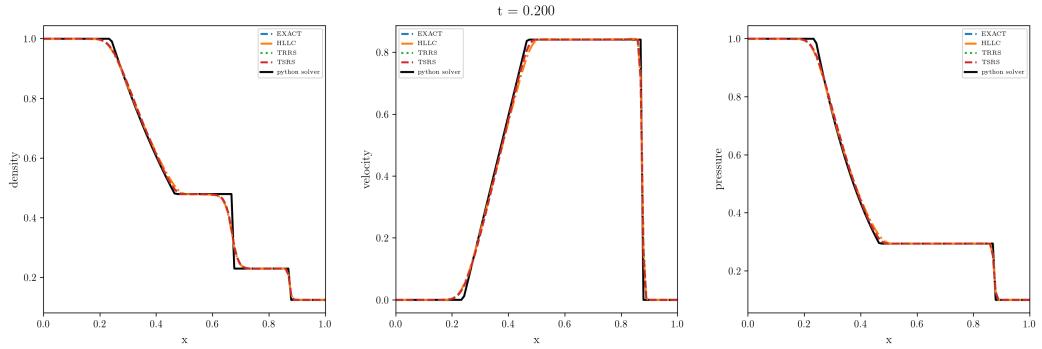


Figure 116: WAF method for (right facing) sod shock, MINMOD flux limiter. Obtained result.

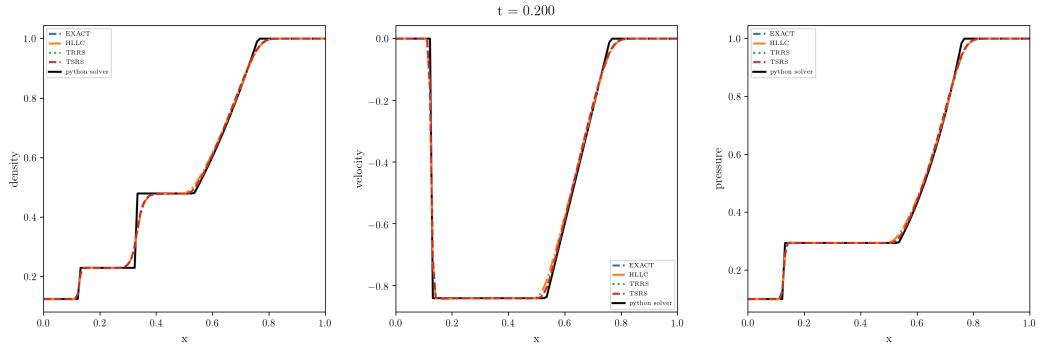


Figure 117: WAF method for (left facing) sod shock, MINMOD flux limiter. Expected result.

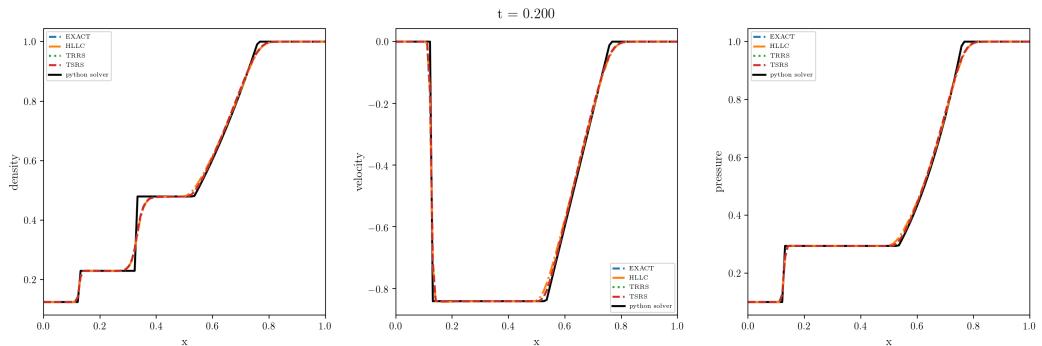


Figure 118: WAF method for (left facing) sod shock, MINMOD flux limiter. Obtained result.

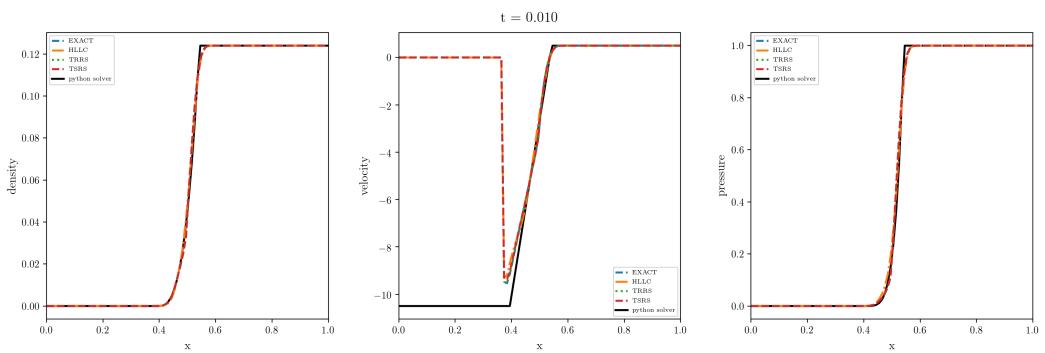


Figure 119: WAF method for left vacuum state, MINMOD flux limiter. Expected result.

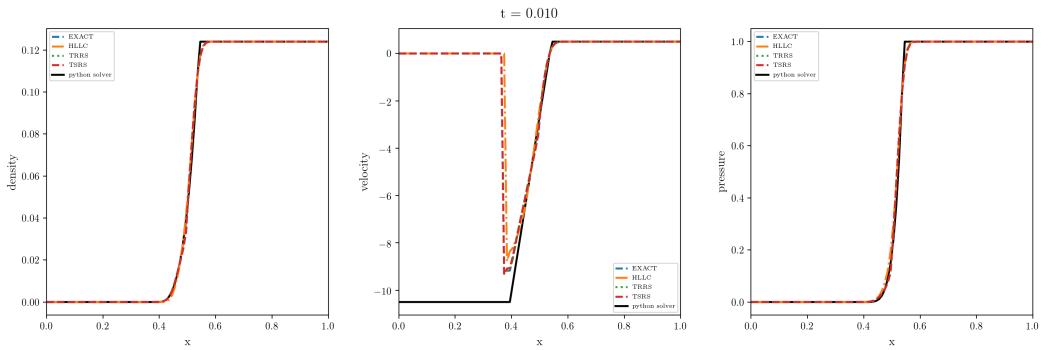


Figure 120: WAF method for left vacuum state, MINMOD flux limiter. Obtained result.

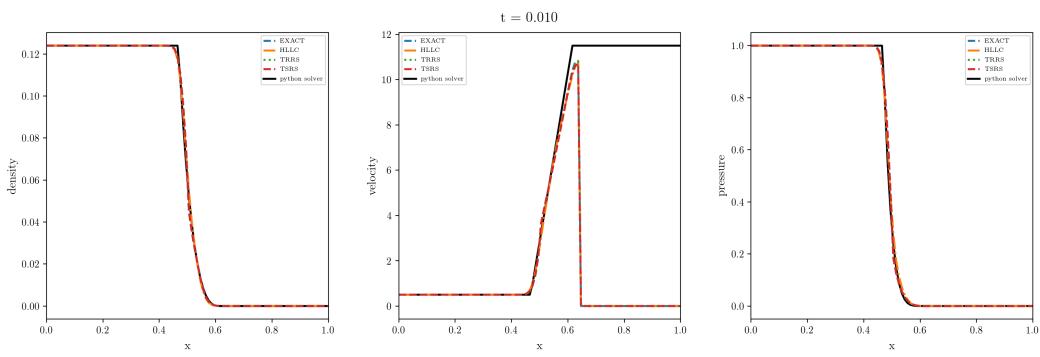


Figure 121: WAF method for left vacuum state, MINMOD flux limiter. Expected result.

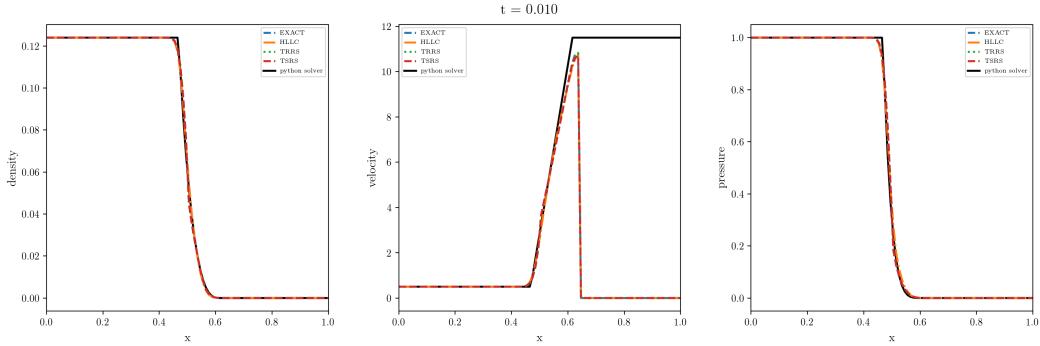


Figure 122: WAF method for left vacuum state, MINMOD flux limiter. Obtained result.

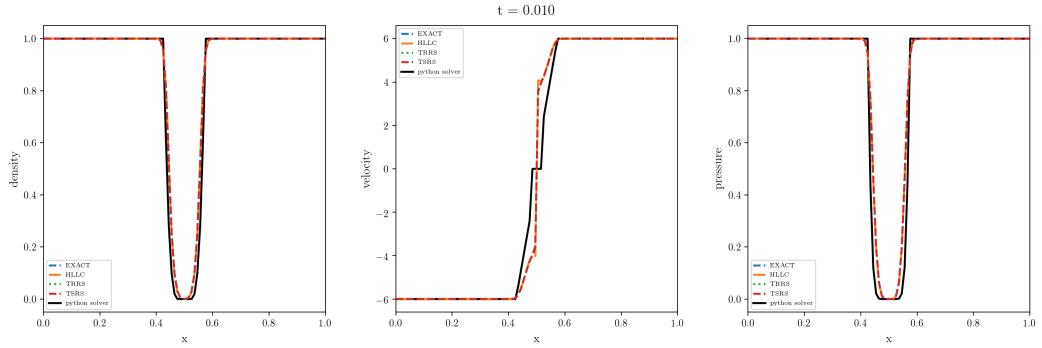


Figure 123: WAF method for vacuum generating conditions, MINMOD flux limiter.
Expected result.

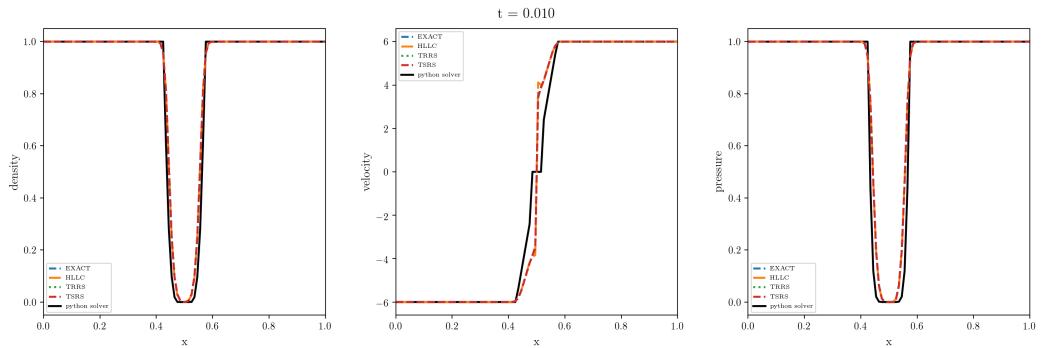


Figure 124: WAF method for vacuum generating conditions, MINMOD flux limiter.
Obtained result.

4.1.4 van Leer limiter

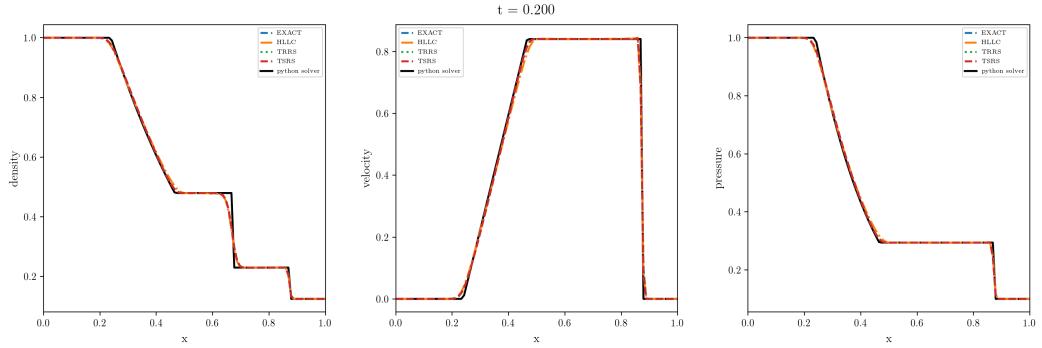


Figure 125: WAF method for (right facing) sod shock, van Leer flux limiter. Expected result.

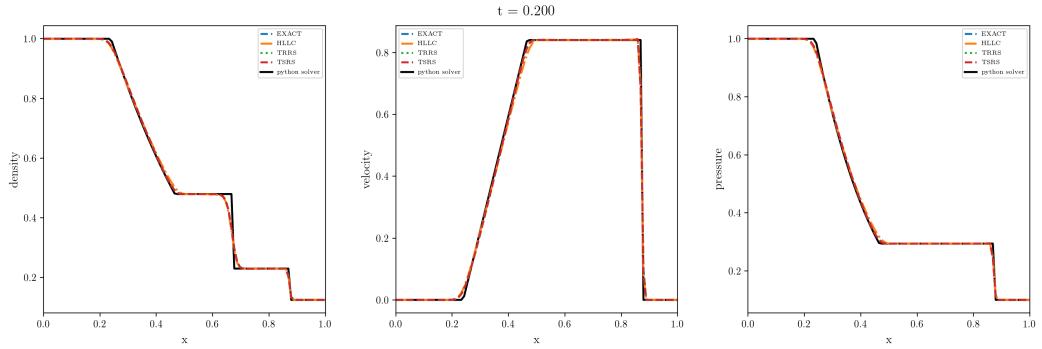


Figure 126: WAF method for (right facing) sod shock, van Leer flux limiter. Obtained result.

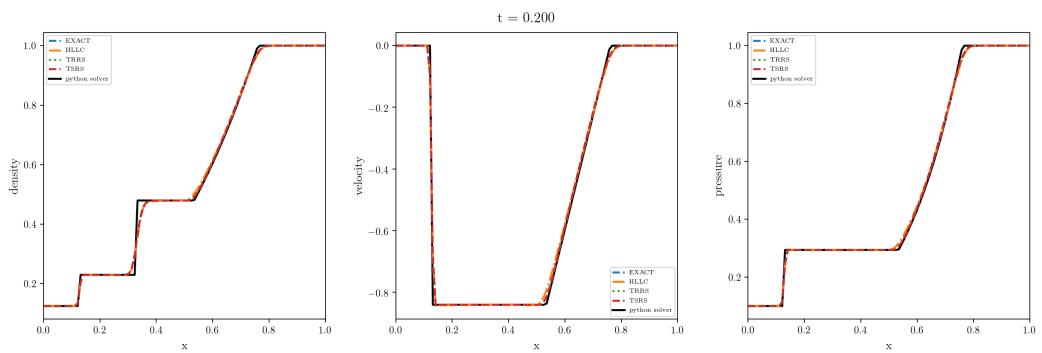


Figure 127: WAF method for (left facing) sod shock, van Leer flux limiter. Expected result.

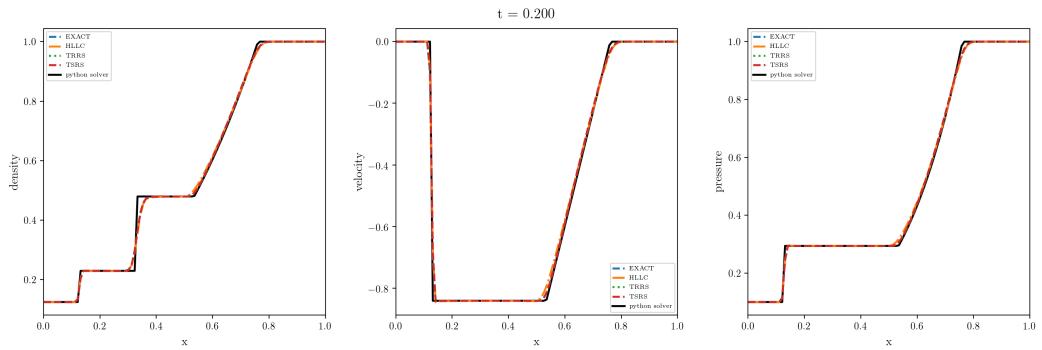


Figure 128: WAF method for (left facing) sod shock, van Leer flux limiter. Obtained result.

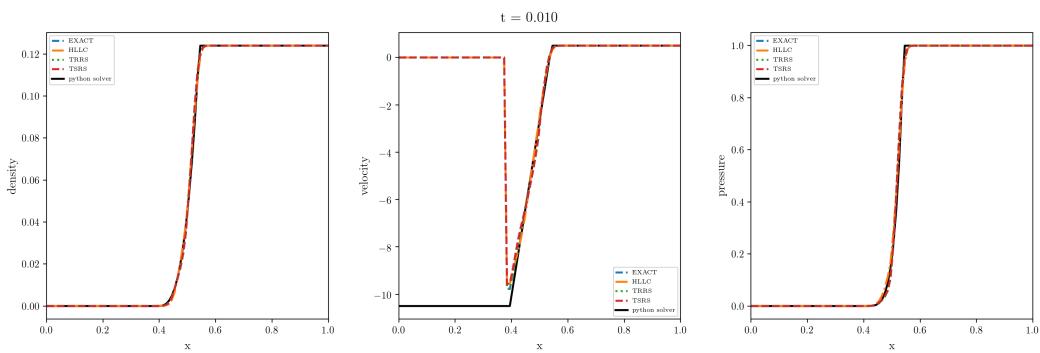


Figure 129: WAF method for left vacuum state, van Leer flux limiter. Expected result.

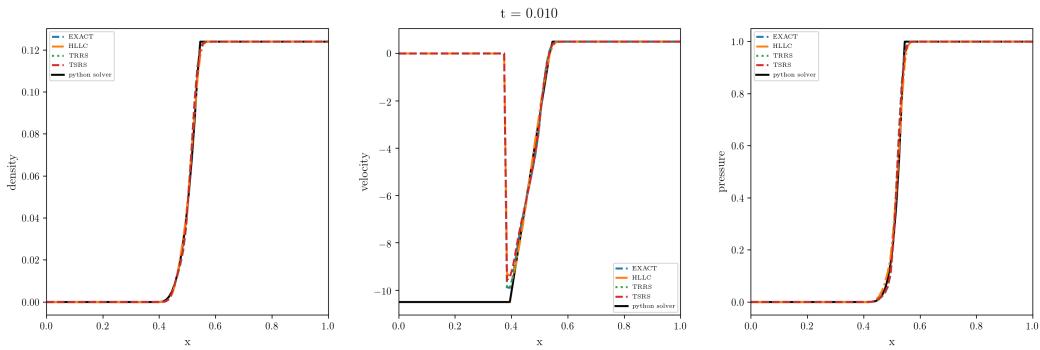


Figure 130: WAF method for left vacuum state, van Leer flux limiter. Obtained result.

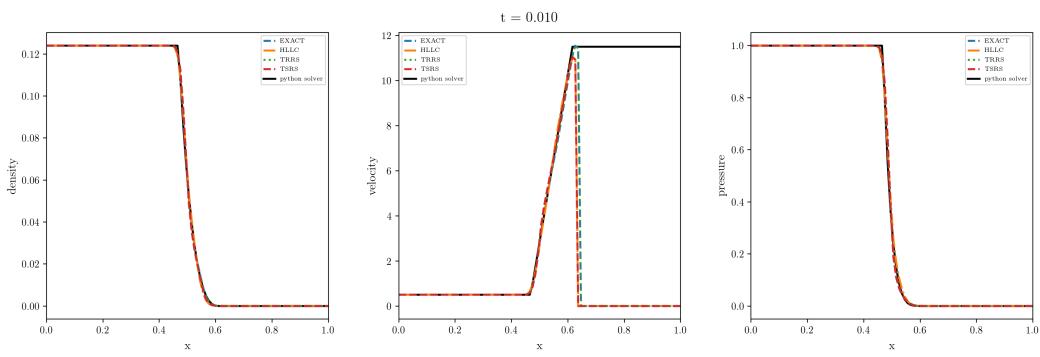


Figure 131: WAF method for left vacuum state, van Leer flux limiter. Expected result.

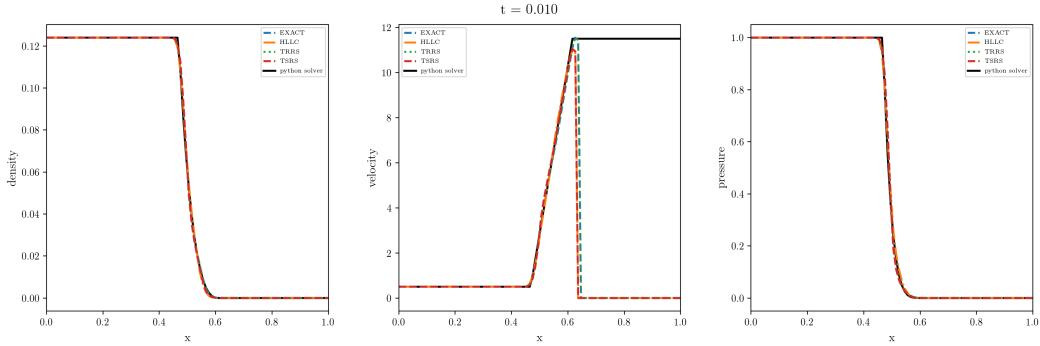


Figure 132: WAF method for left vacuum state, van Leer flux limiter. Obtained result.

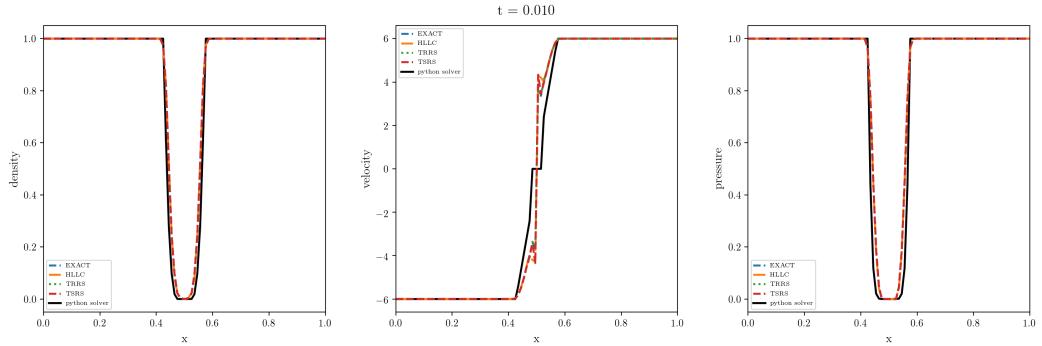


Figure 133: WAF method for vacuum generating conditions, van Leer flux limiter.
Expected result.

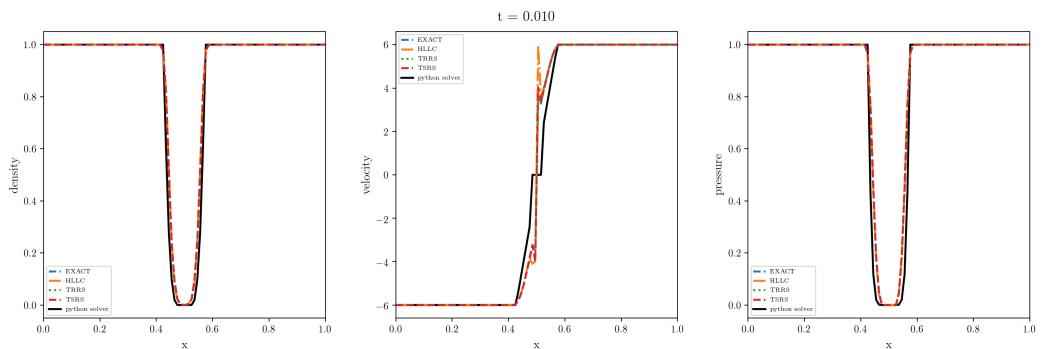


Figure 134: WAF method for vacuum generating conditions, van Leer flux limiter.
Obtained result.

4.1.5 SUPERBEE limiter

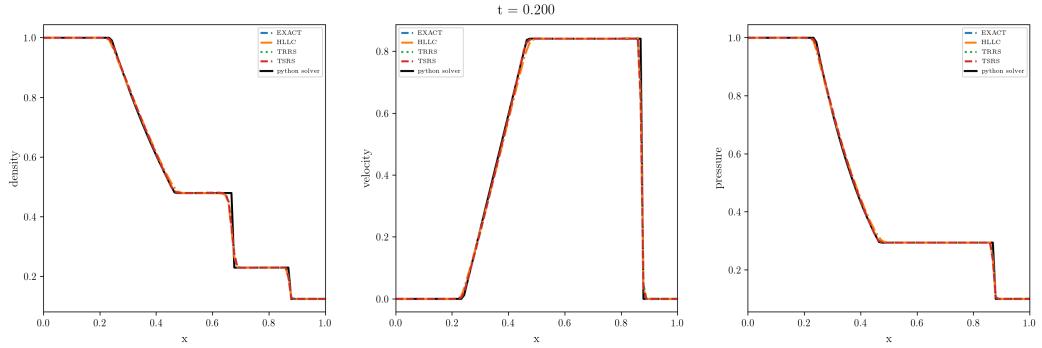


Figure 135: WAF method for (right facing) sod shock, SUPERBEE flux limiter. Expected result.

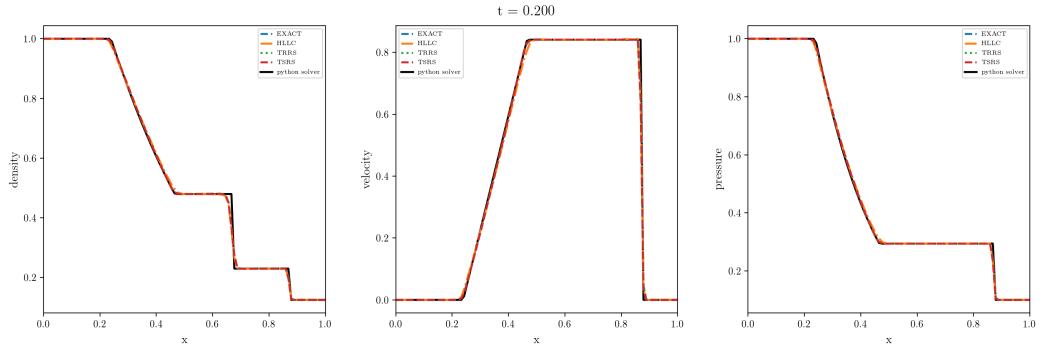


Figure 136: WAF method for (right facing) sod shock, SUPERBEE flux limiter. Obtained result.

4.2 2D with different Limiters

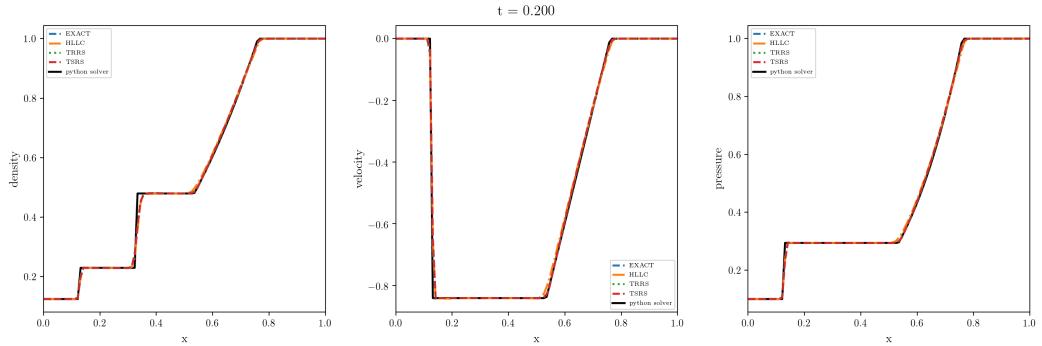


Figure 137: WAF method for (left facing) sod shock, SUPERBEE flux limiter. Expected result.

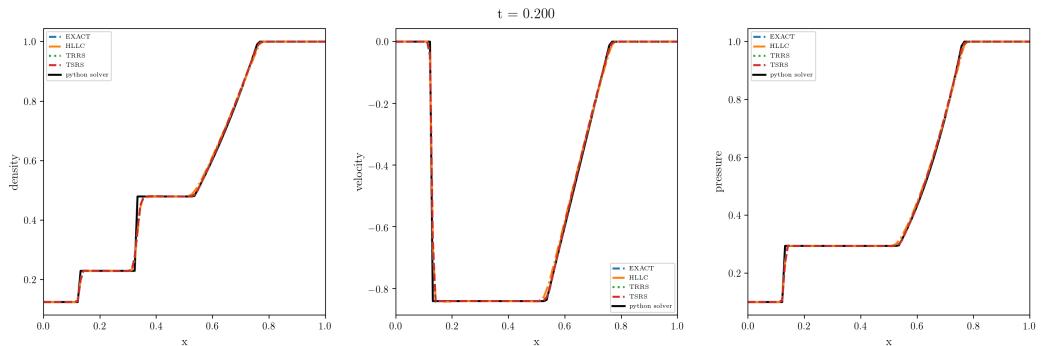


Figure 138: WAF method for (left facing) sod shock, SUPERBEE flux limiter. Obtained result.

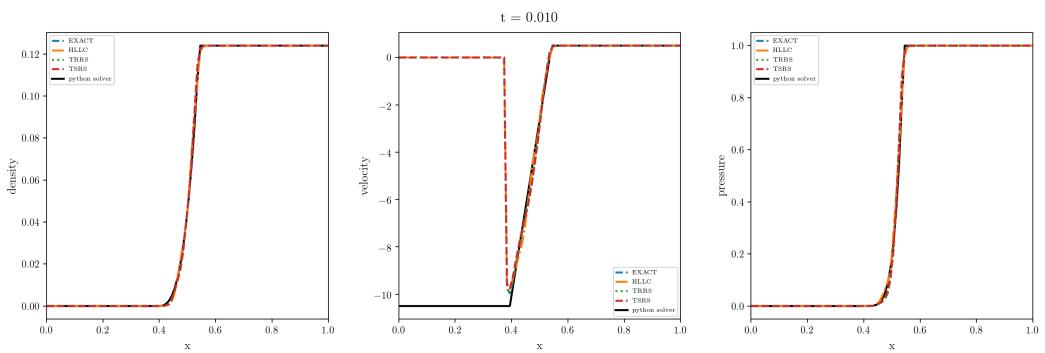


Figure 139: WAF method for left vacuum state, SUPERBEE flux limiter. Expected result.

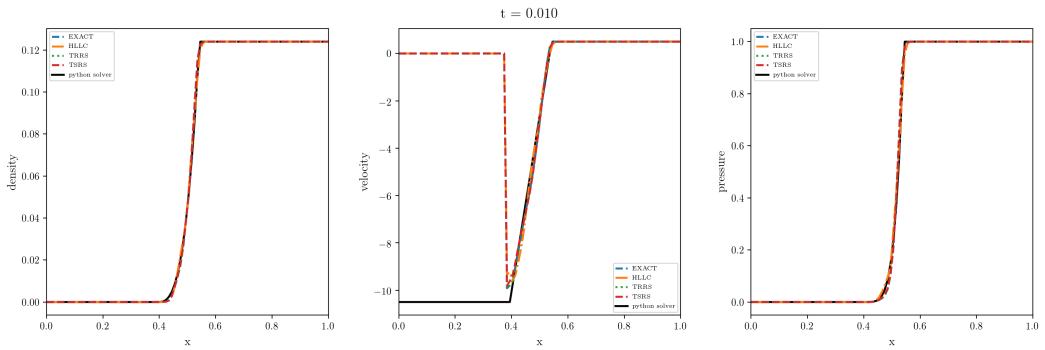


Figure 140: WAF method for left vacuum state, SUPERBEE flux limiter. Obtained result.

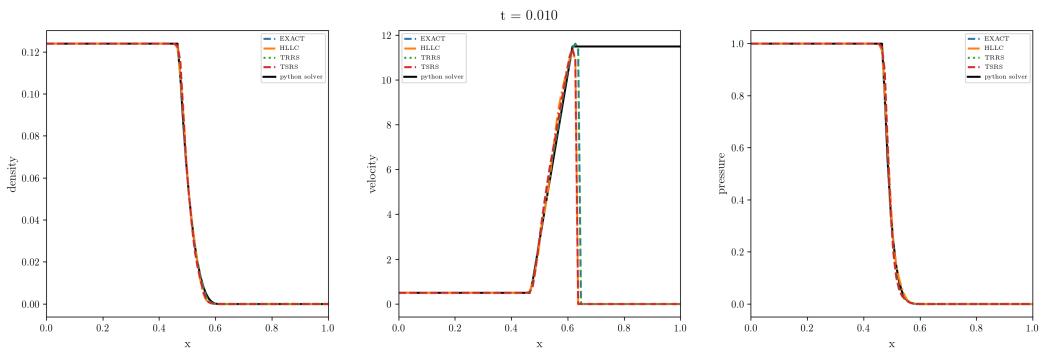


Figure 141: WAF method for left vacuum state, SUPERBEE flux limiter. Expected result.

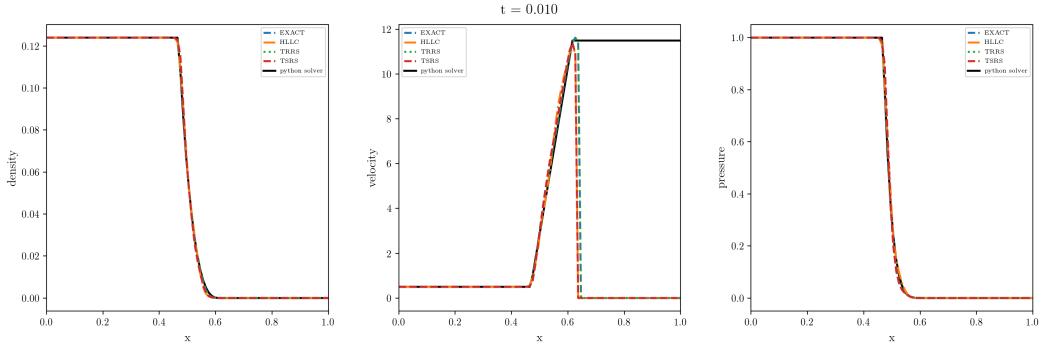


Figure 142: WAF method for left vacuum state, SUPERBEE flux limiter. Obtained result.

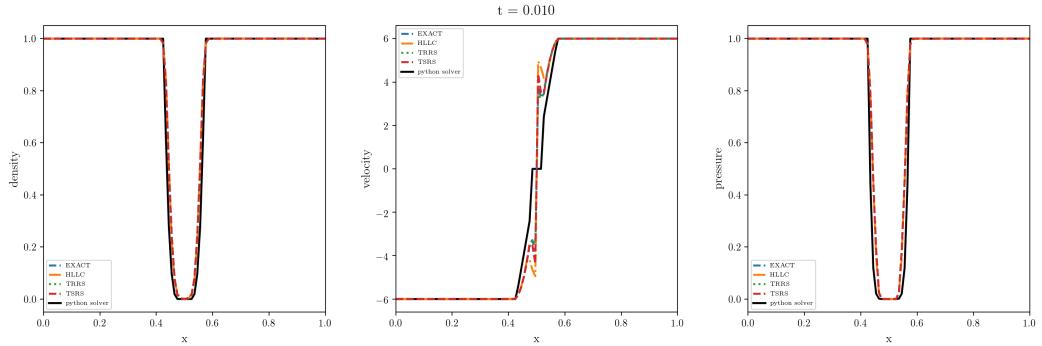


Figure 143: WAF method for vacuum generating conditions, SUPERBEE flux limiter.
Expected result.

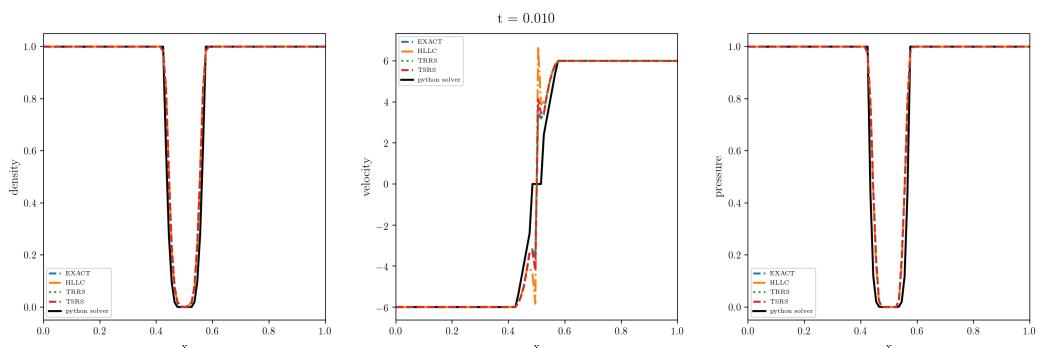


Figure 144: WAF method for vacuum generating conditions, SUPERBEE flux limiter.
Obtained result.

4.2.1 MC limiter

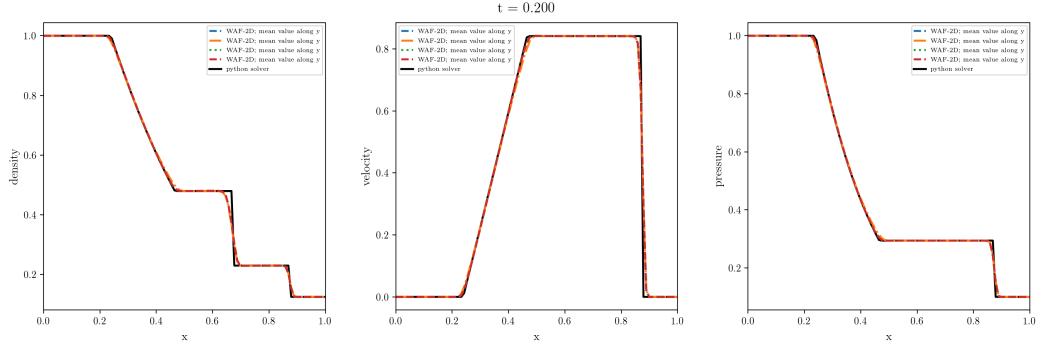


Figure 145: WAF method for (right facing) sod shock, MC flux limiter. Expected result.

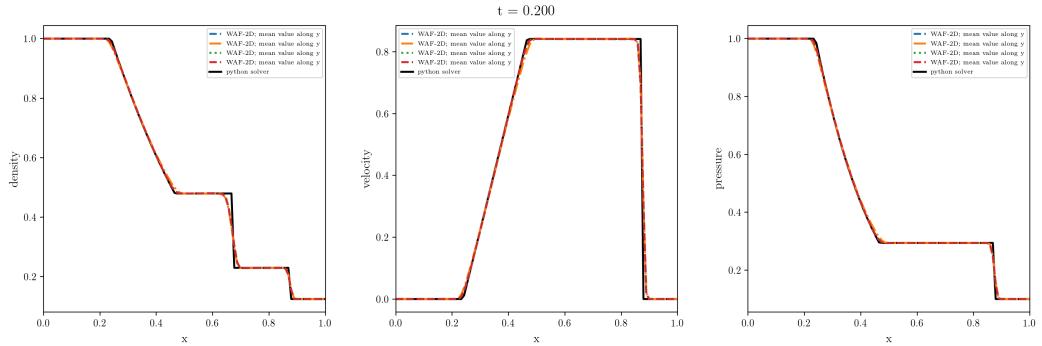


Figure 146: WAF method for (right facing) sod shock, MC flux limiter. Obtained result.

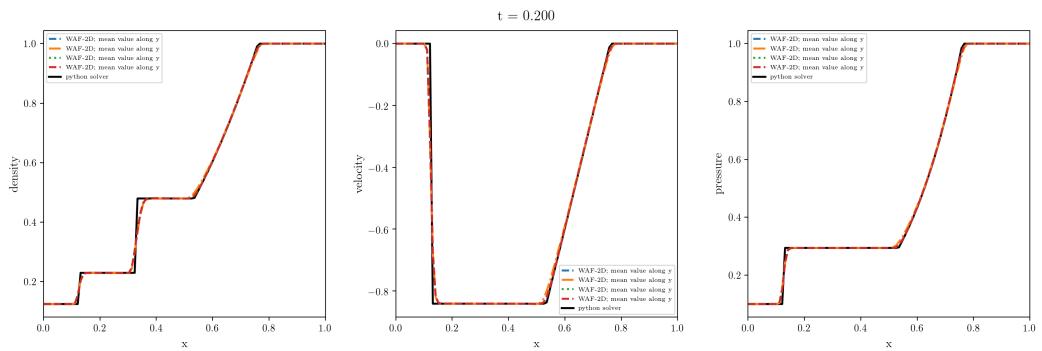


Figure 147: WAF method for (left facing) sod shock, MC flux limiter. Expected result.

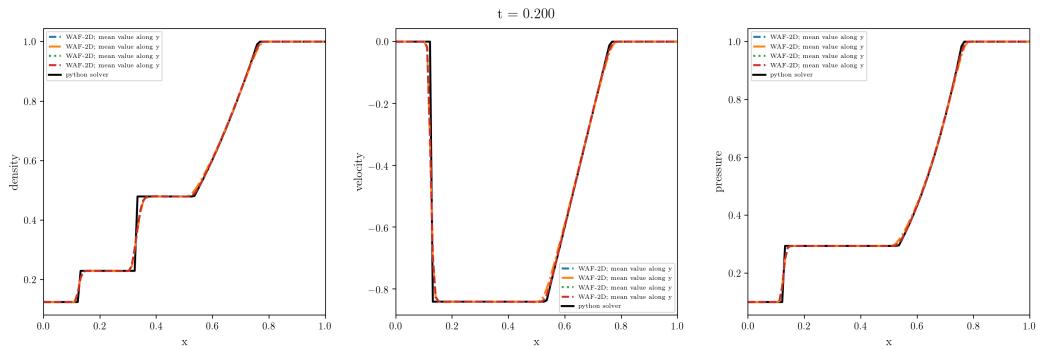


Figure 148: WAF method for (left facing) sod shock, MC flux limiter. Obtained result.

4.2.2 MINMOD limiter

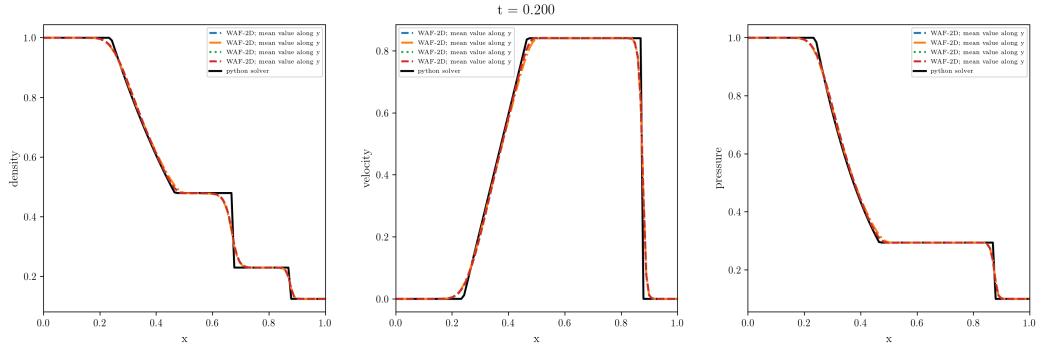


Figure 149: WAF method for (right facing) sod shock, MINMOD flux limiter. Expected result.

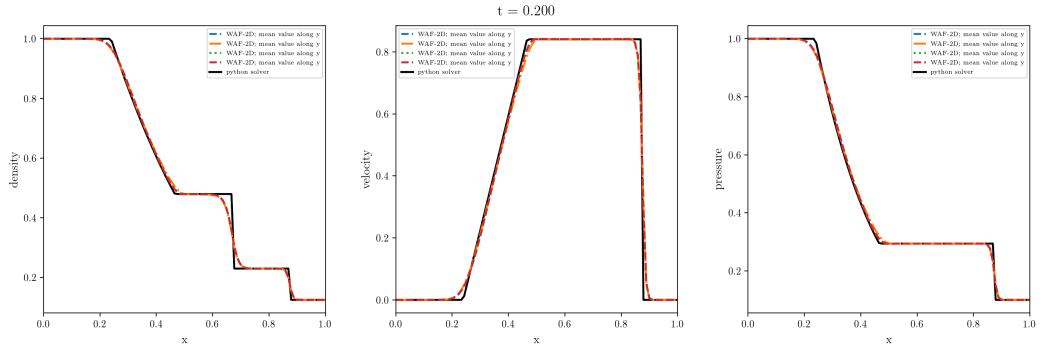


Figure 150: WAF method for (right facing) sod shock, MINMOD flux limiter. Obtained result.

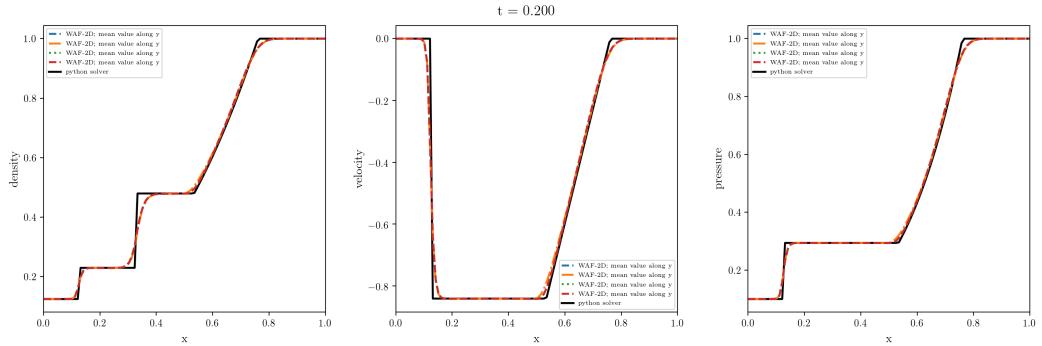


Figure 151: WAF method for (left facing) sod shock, MINMOD flux limiter. Expected result.

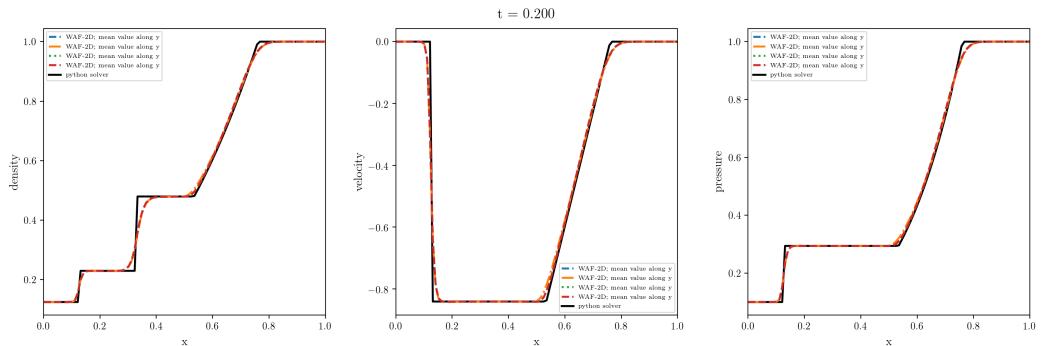


Figure 152: WAF method for (left facing) sod shock, MINMOD flux limiter. Obtained result.

4.2.3 van Leer limiter

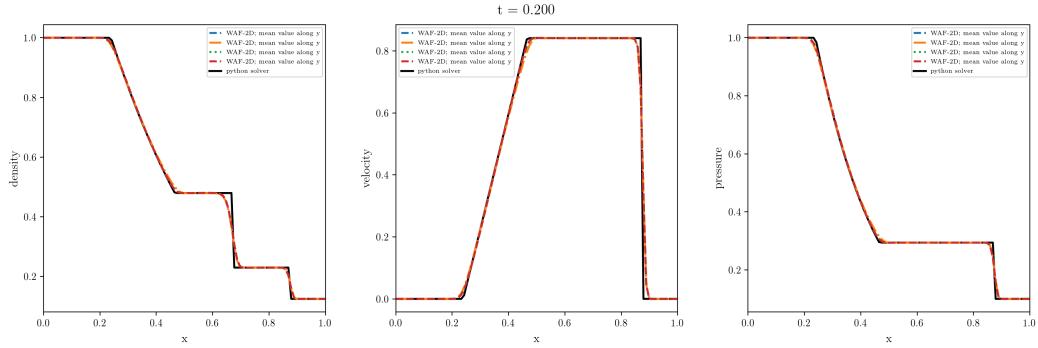


Figure 153: WAF method for (right facing) sod shock, van Leer flux limiter. Expected result.

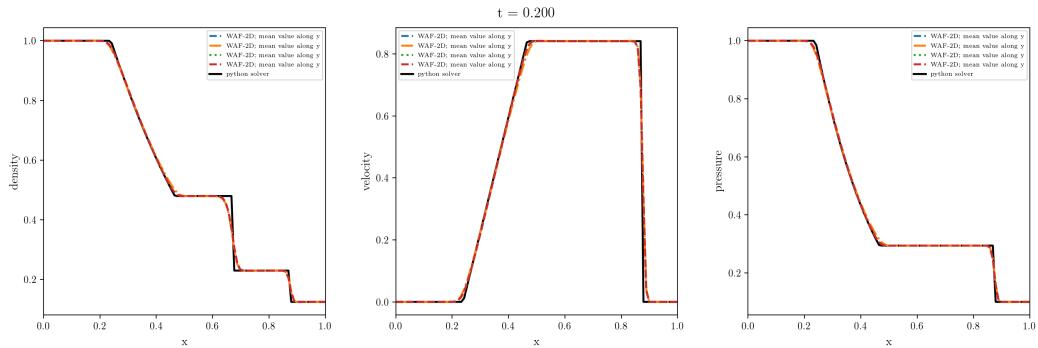


Figure 154: WAF method for (right facing) sod shock, van Leer flux limiter. Obtained result.

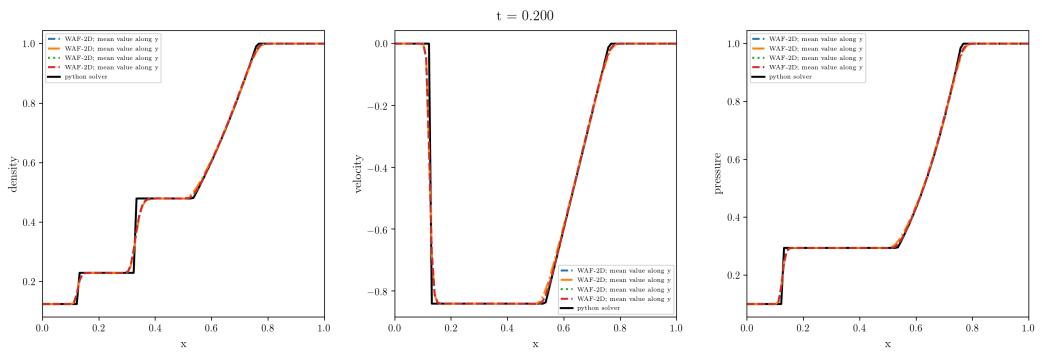


Figure 155: WAF method for (left facing) sod shock, van Leer flux limiter. Expected result.

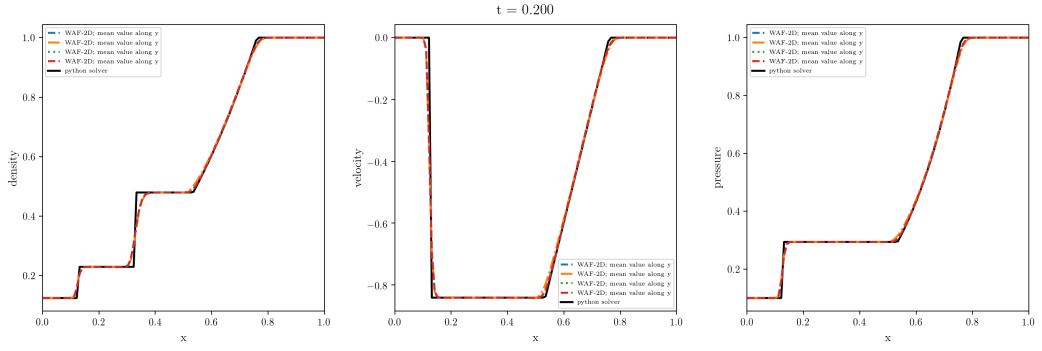


Figure 156: WAF method for (left facing) sod shock, van Leer flux limiter. Obtained result.

4.2.4 SUPERBEE limiter

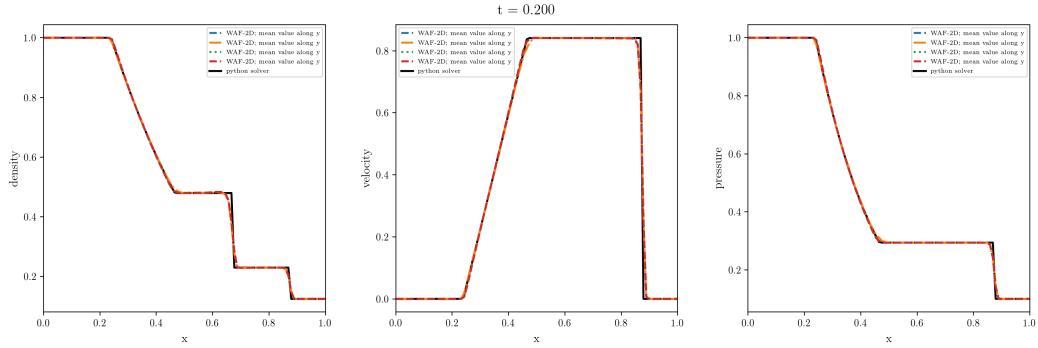


Figure 157: WAF method for (right facing) sod shock, SUPERBEE flux limiter. Expected result.

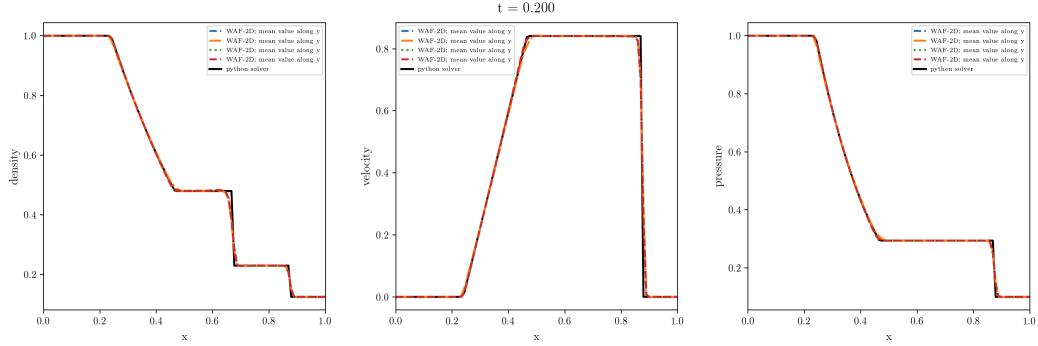


Figure 158: WAF method for (right facing) sod shock, SUPERBEE flux limiter. Obtained result.

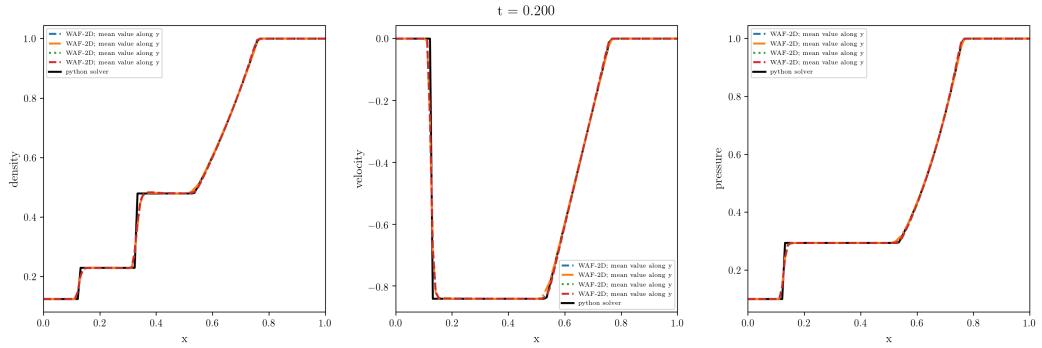


Figure 159: WAF method for (left facing) sod shock, SUPERBEE flux limiter. Expected result.

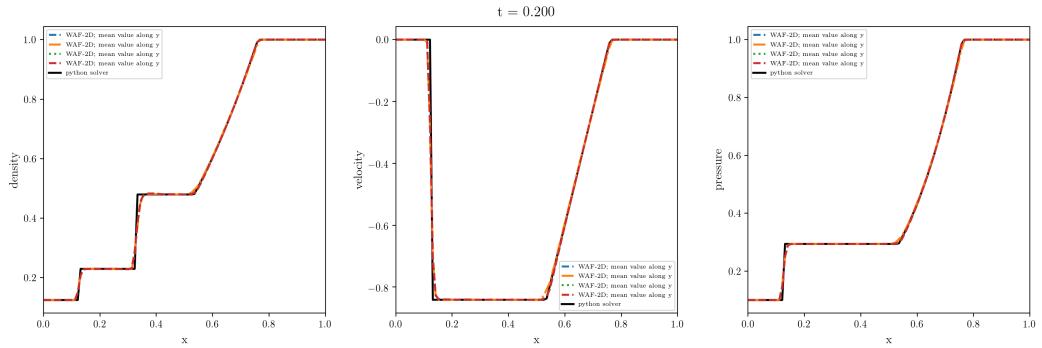


Figure 160: WAF method for (left facing) sod shock, SUPERBEE flux limiter. Obtained result.

4.3 Others in 2D

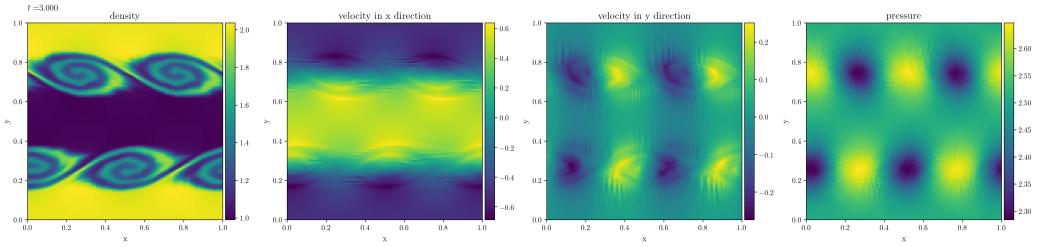


Figure 161: WAF method for Kelvin Helmholtz instability. Expected result with HLLC solver and van Leer limiter.

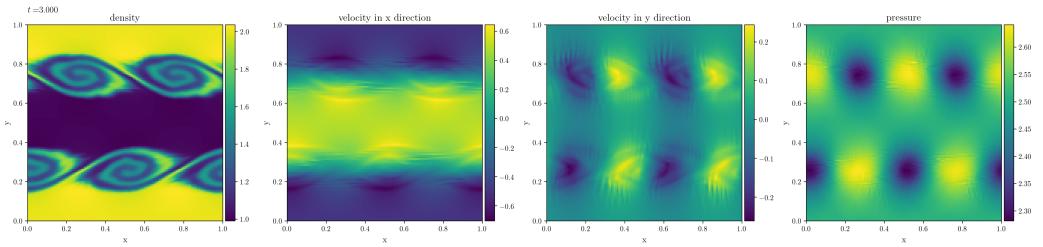


Figure 162: WAF method for Kelvin Helmholtz instability. Obtained result with HLLC solver and van Leer limiter.

5 MUSCL Method

5.1 1D with different Limiters

5.1.1 Without limiter

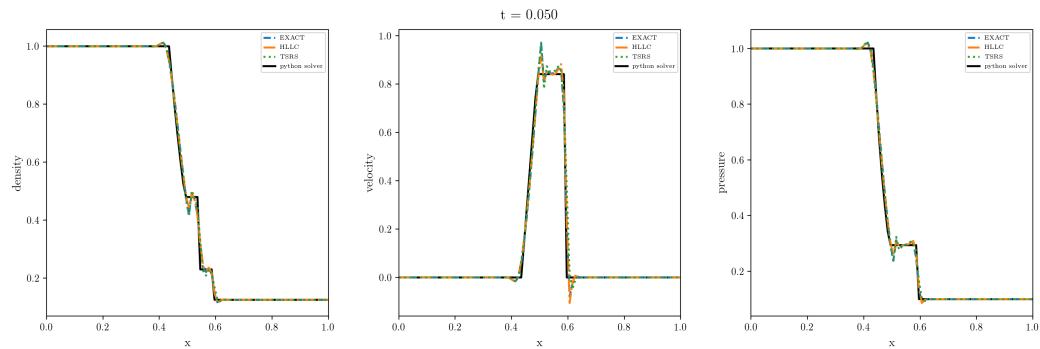


Figure 163: MUSCL method for (right facing) sod shock, no flux limiter. Expected result.

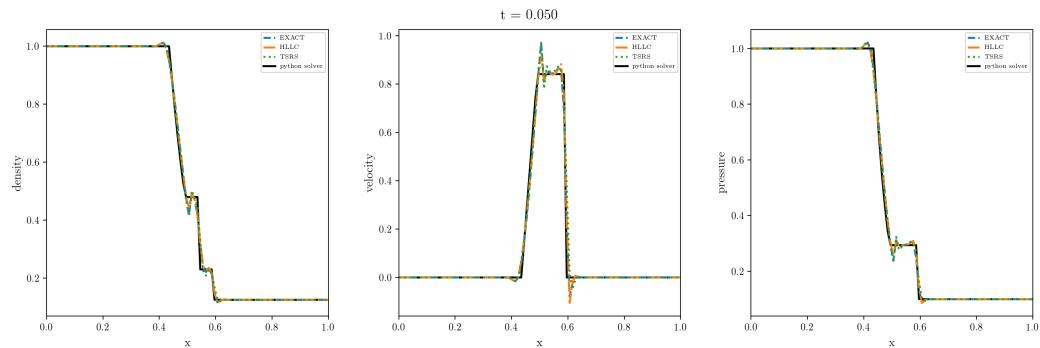


Figure 164: MUSCL method for (right facing) sod shock, no flux limiter. Obtained result.

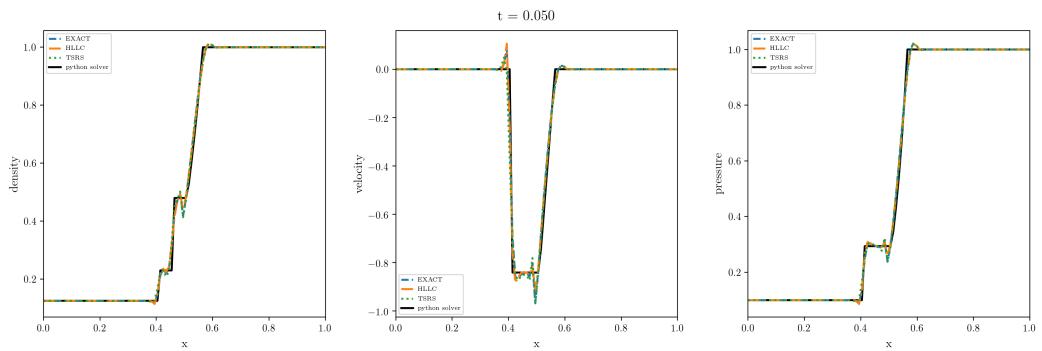


Figure 165: MUSCL method for (left facing) sod shock, no flux limiter. Expected result.

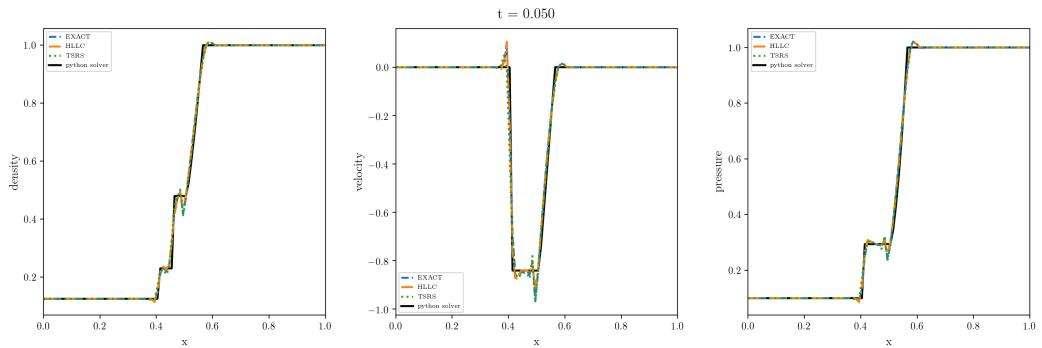


Figure 166: MUSCL method for (left facing) sod shock, no flux limiter. Obtained result.

5.1.2 MINMOD limiter

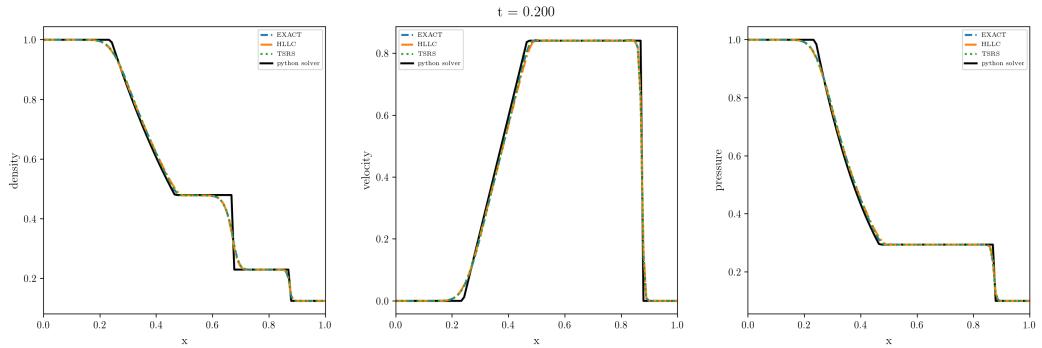


Figure 167: MUSCL method for (right facing) sod shock, MINMOD flux limiter. Expected result.

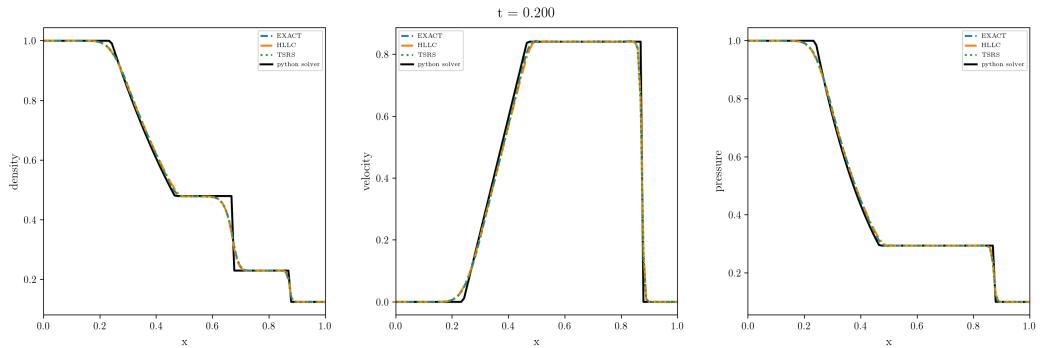


Figure 168: MUSCL method for (right facing) sod shock, MINMOD flux limiter. Obtained result.

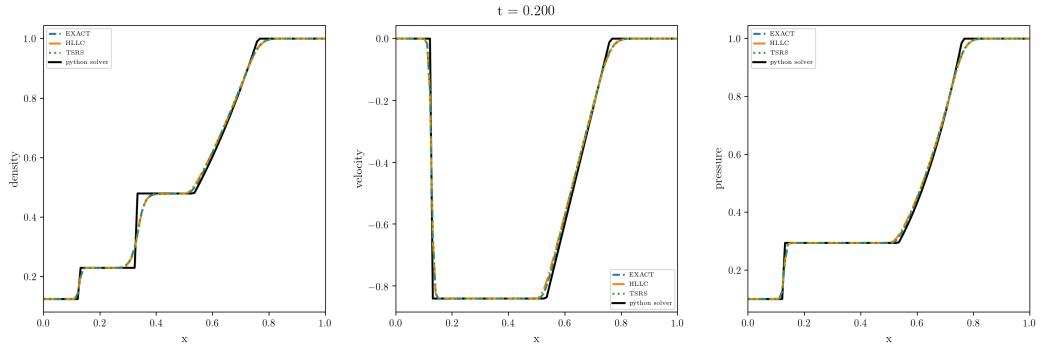


Figure 169: MUSCL method for (left facing) sod shock, MINMOD flux limiter. Expected result.

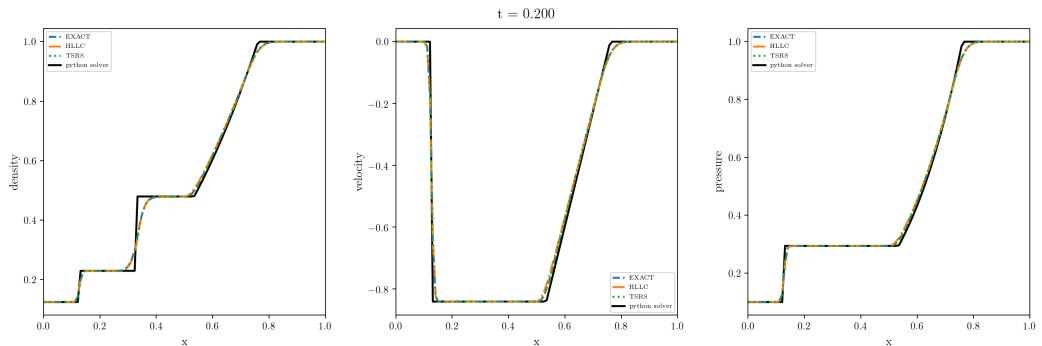


Figure 170: MUSCL method for (left facing) sod shock, MINMOD flux limiter. Obtained result.

5.1.3 van Leer limiter

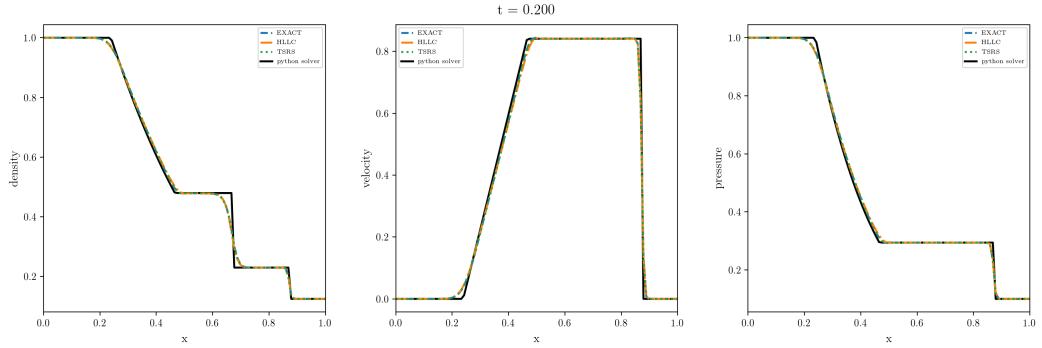


Figure 171: MUSCL method for (right facing) sod shock, van Leer flux limiter. Expected result.

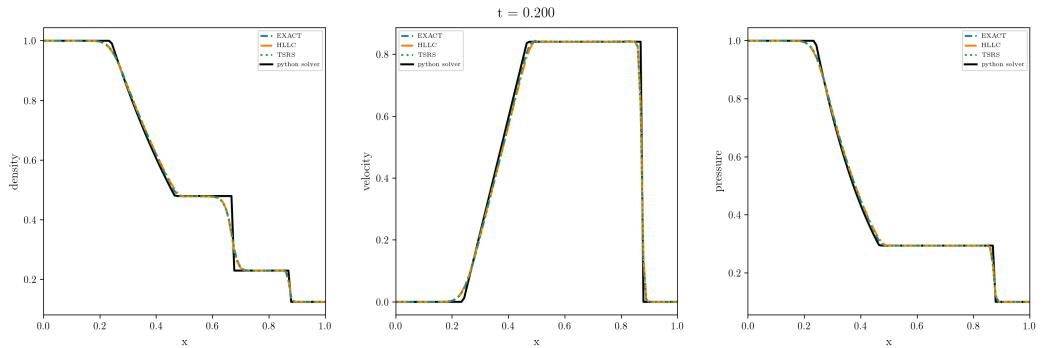


Figure 172: MUSCL method for (right facing) sod shock, van Leer flux limiter. Obtained result.

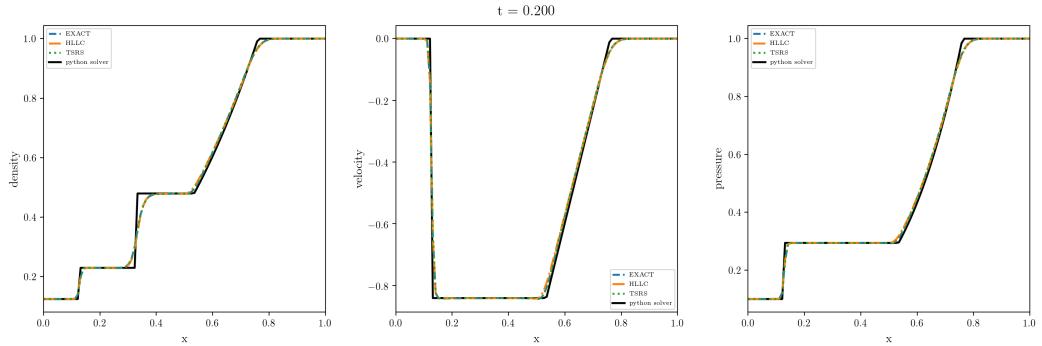


Figure 173: MUSCL method for (left facing) sod shock, van Leer flux limiter. Expected result.

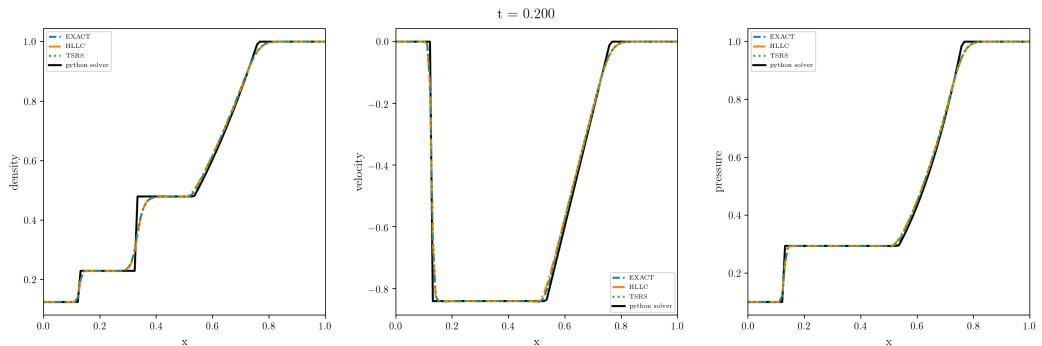


Figure 174: MUSCL method for (left facing) sod shock, van Leer flux limiter. Obtained result.

5.1.4 SUPERBEE limiter

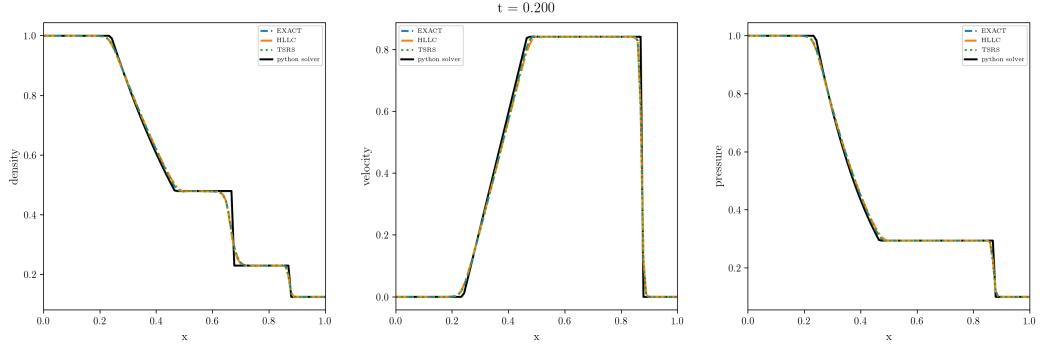


Figure 175: MUSCL method for (right facing) sod shock, SUPERBEE flux limiter.
Expected result.

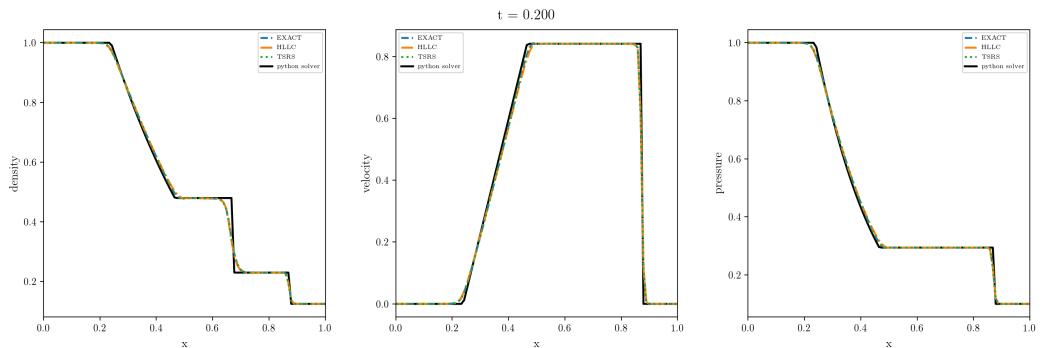


Figure 176: MUSCL method for (right facing) sod shock, SUPERBEE flux limiter.
Obtained result.

5.2 2D with different Limiters

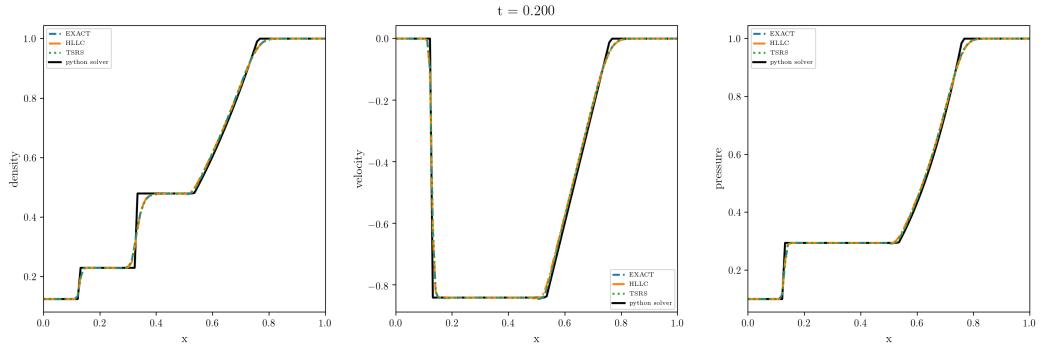


Figure 177: MUSCL method for (left facing) sod shock, SUPERBEE flux limiter. Expected result.

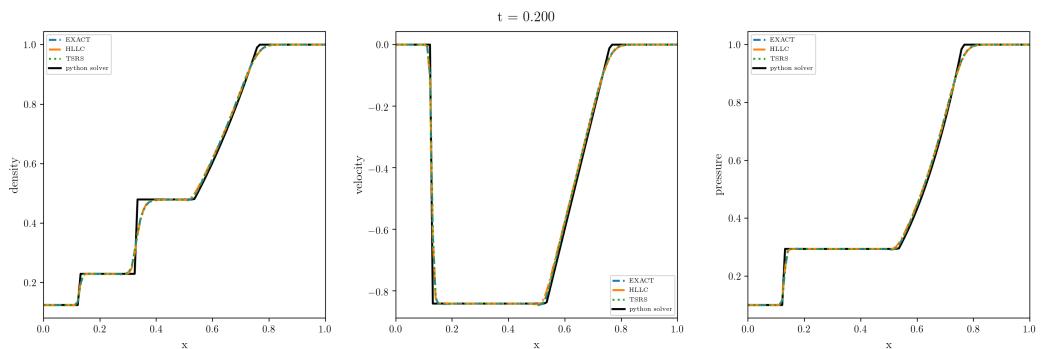


Figure 178: MUSCL method for (left facing) sod shock, SUPERBEE flux limiter. Obtained result.

5.2.1 MINMOD limiter

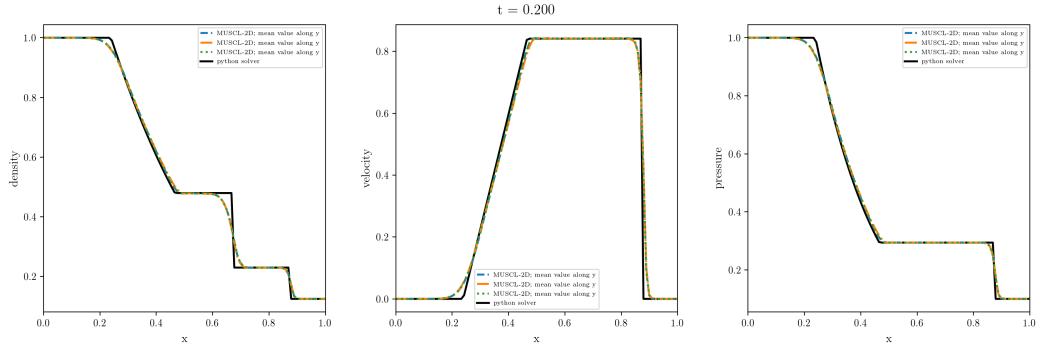


Figure 179: MUSCL method for (right facing) sod shock, MINMOD flux limiter. Expected result.

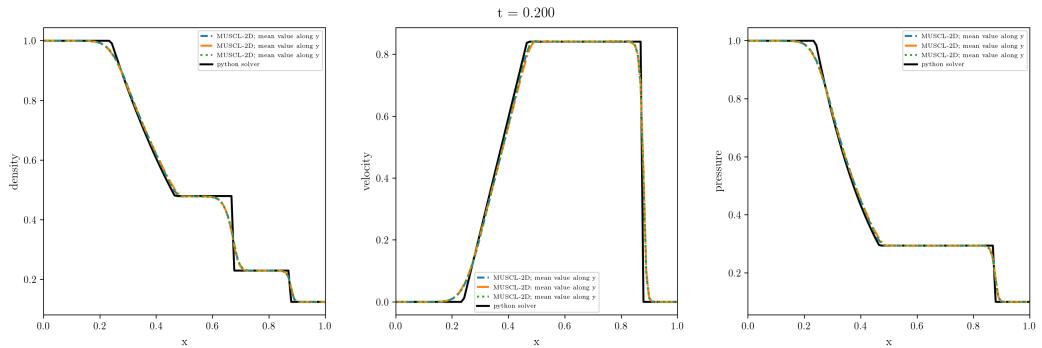


Figure 180: MUSCL method for (right facing) sod shock, MINMOD flux limiter. Obtained result.

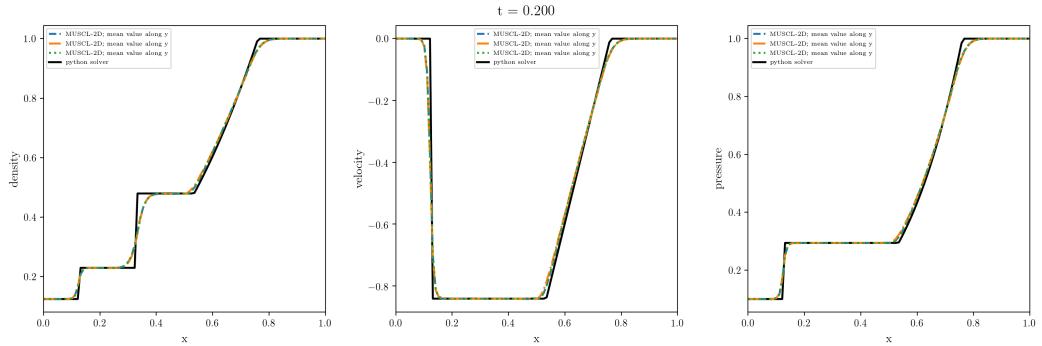


Figure 181: MUSCL method for (left facing) sod shock, MINMOD flux limiter. Expected result.

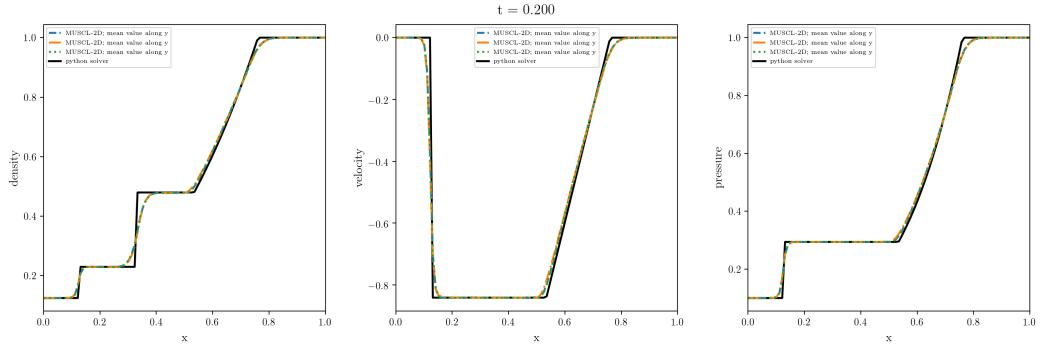


Figure 182: MUSCL method for (left facing) sod shock, MINMOD flux limiter. Obtained result.

5.2.2 van Leer limiter

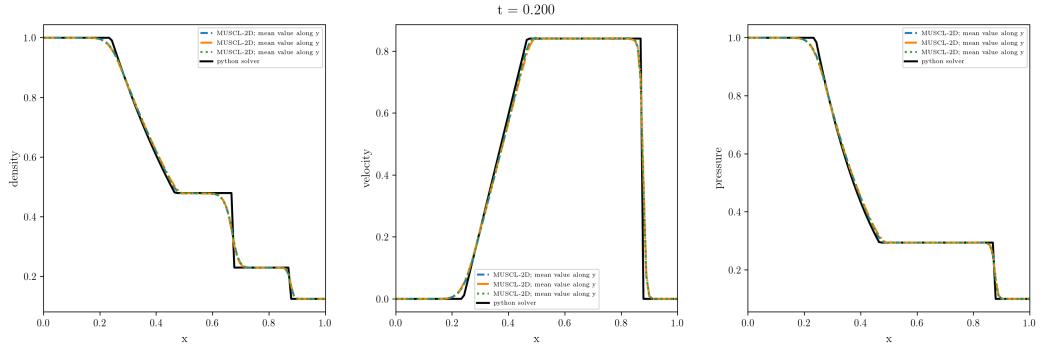


Figure 183: MUSCL method for (right facing) sod shock, van Leer flux limiter. Expected result.

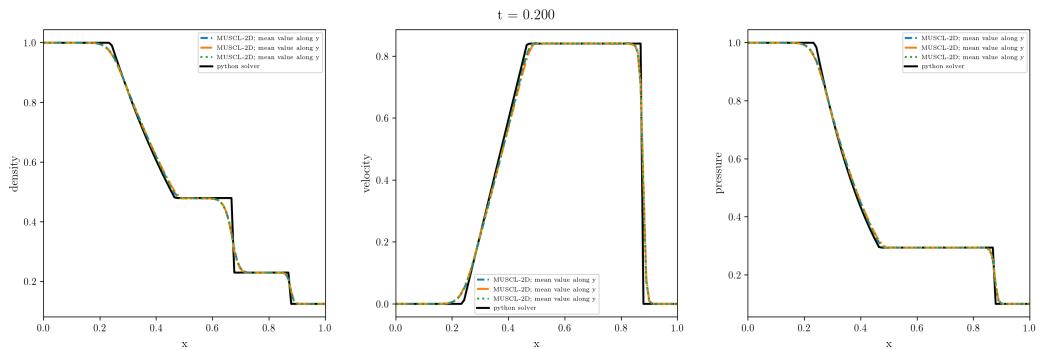


Figure 184: MUSCL method for (right facing) sod shock, van Leer flux limiter. Obtained result.

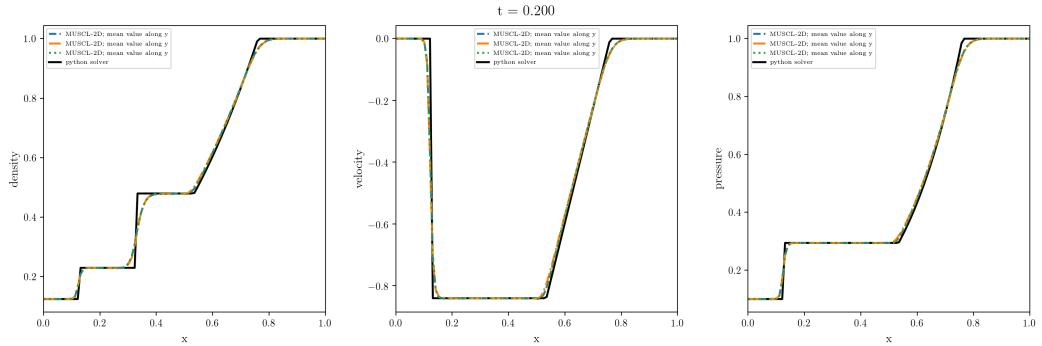


Figure 185: MUSCL method for (left facing) sod shock, van Leer flux limiter. Expected result.

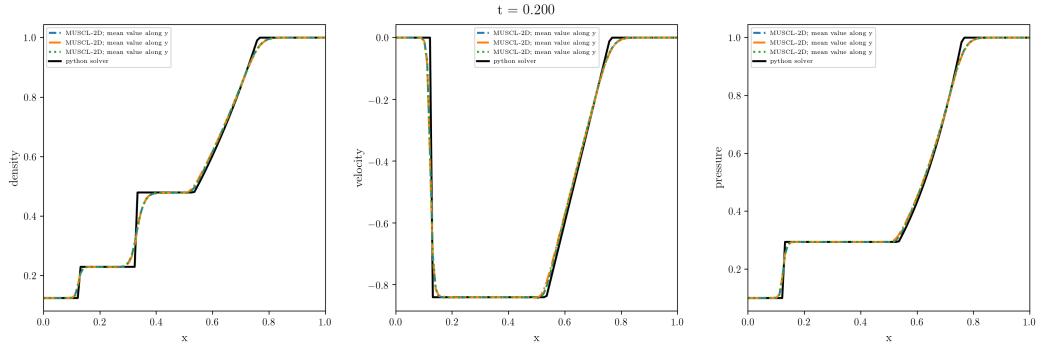


Figure 186: MUSCL method for (left facing) sod shock, van Leer flux limiter. Obtained result.

5.2.3 SUPERBEE limiter

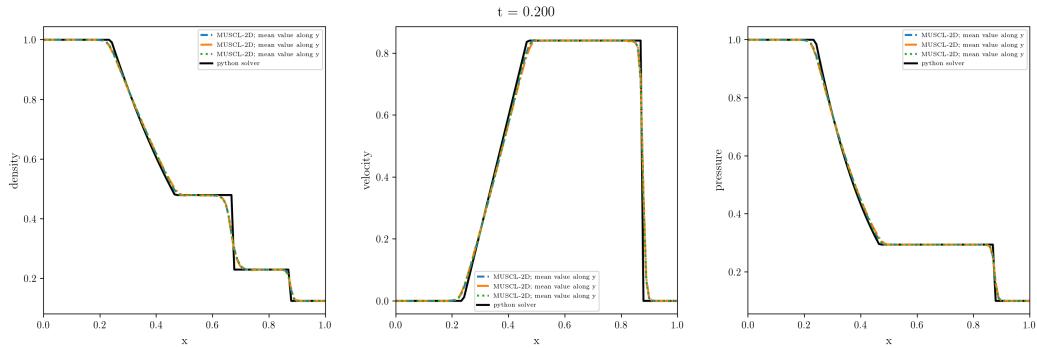


Figure 187: MUSCL method for (right facing) sod shock, SUPERBEE flux limiter.
Expected result.

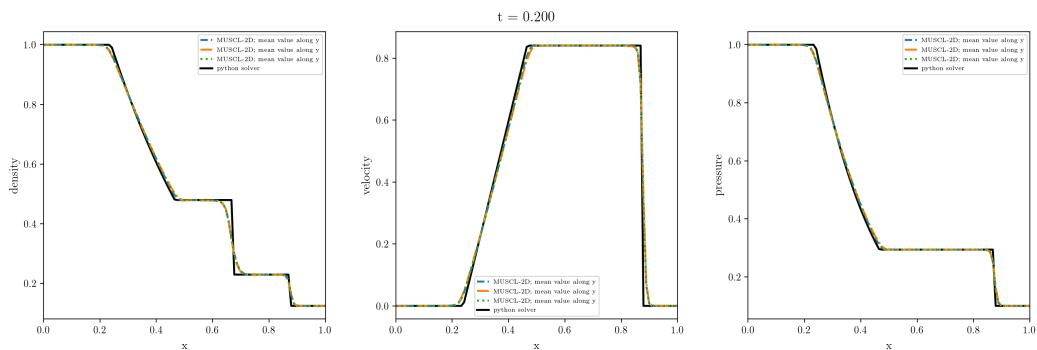


Figure 188: MUSCL method for (right facing) sod shock, SUPERBEE flux limiter.
Obtained result.

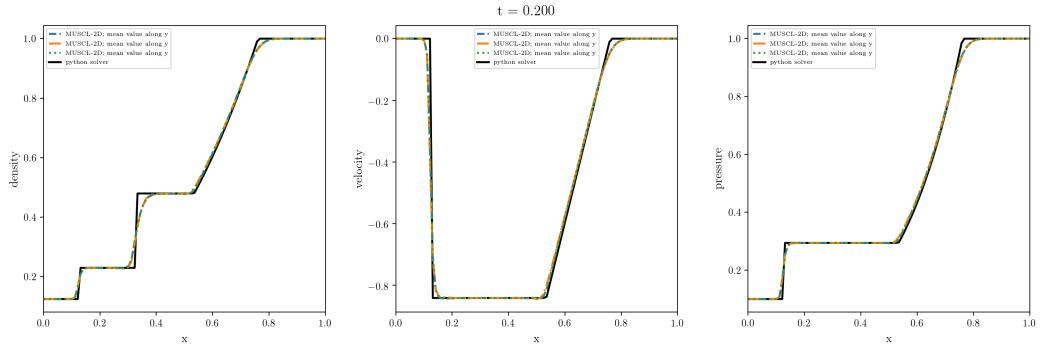


Figure 189: MUSCL method for (left facing) sod shock, SUPERBEE flux limiter. Expected result.

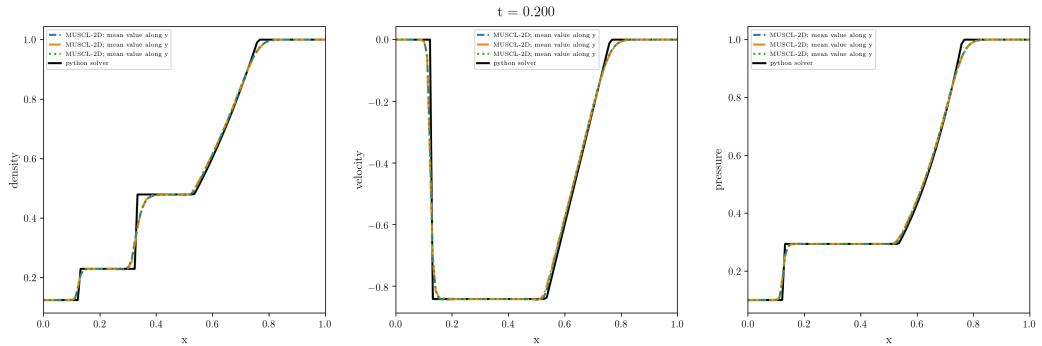


Figure 190: MUSCL method for (left facing) sod shock, SUPERBEE flux limiter. Obtained result.

5.3 Others in 2D

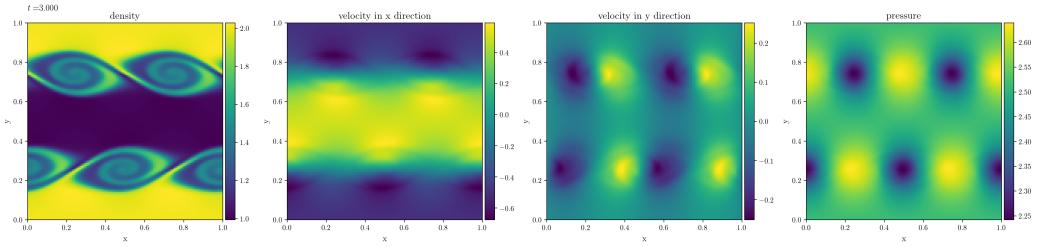


Figure 191: MUSCL method for Kelvin Helmholtz instability. Expected result with HLLC solver and van Leer limiter.

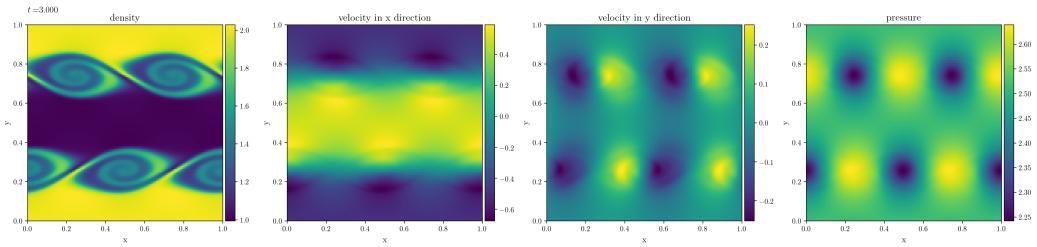


Figure 192: MUSCL method for Kelvin Helmholtz instability. Obtained result with HLLC solver and van Leer limiter.