Test Results for Mesh Hydro Code

This computer

Contents

1 Advection

1.1 Piecewise Constant

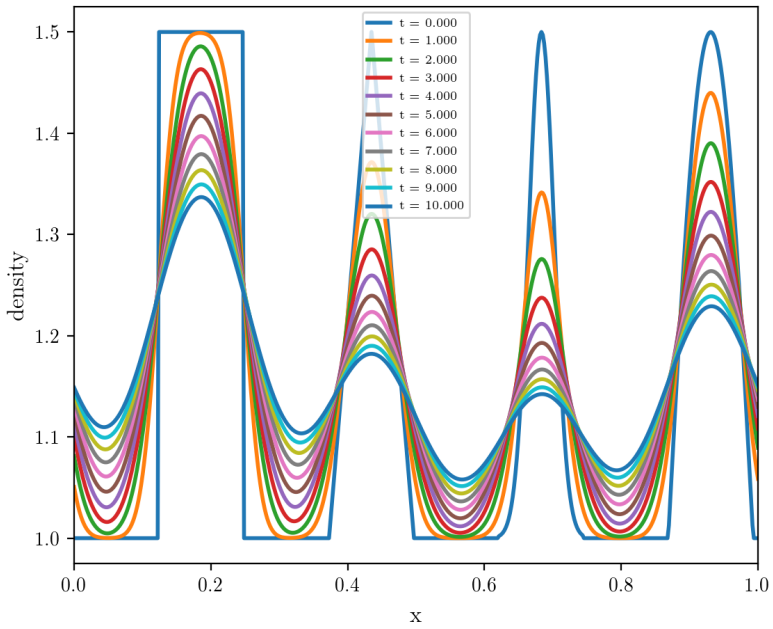
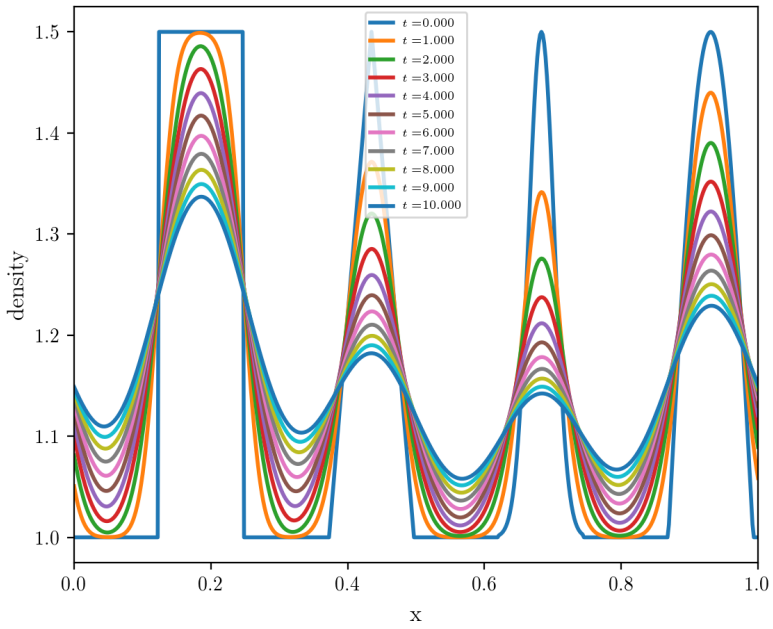


Figure 1: Expected result 1D



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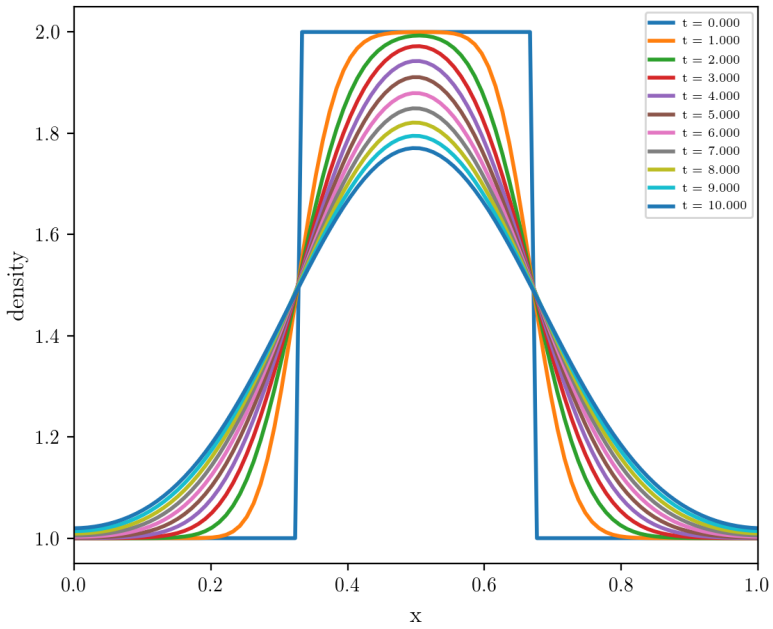

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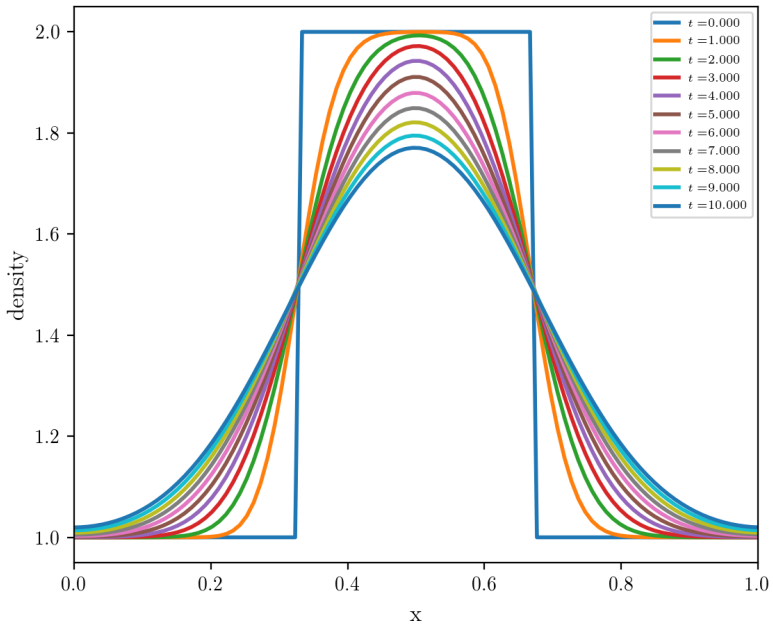

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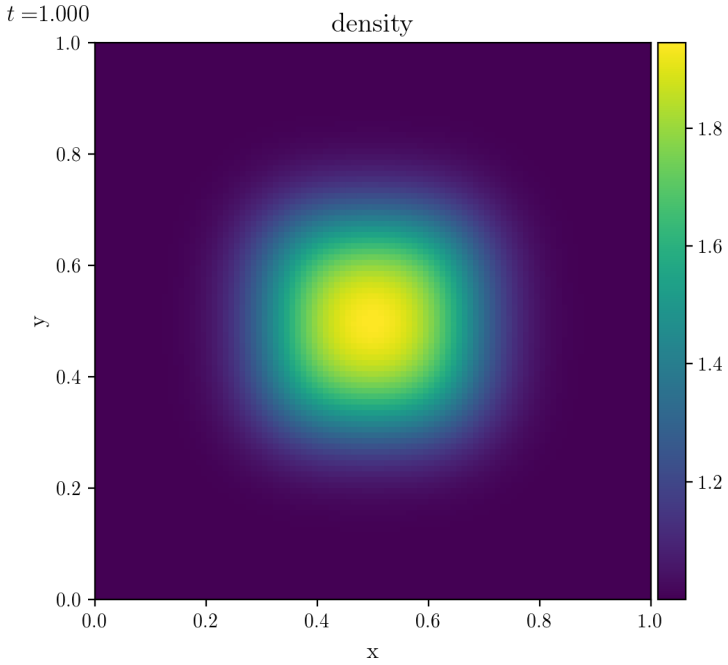


Figure 5: Expected result 2D

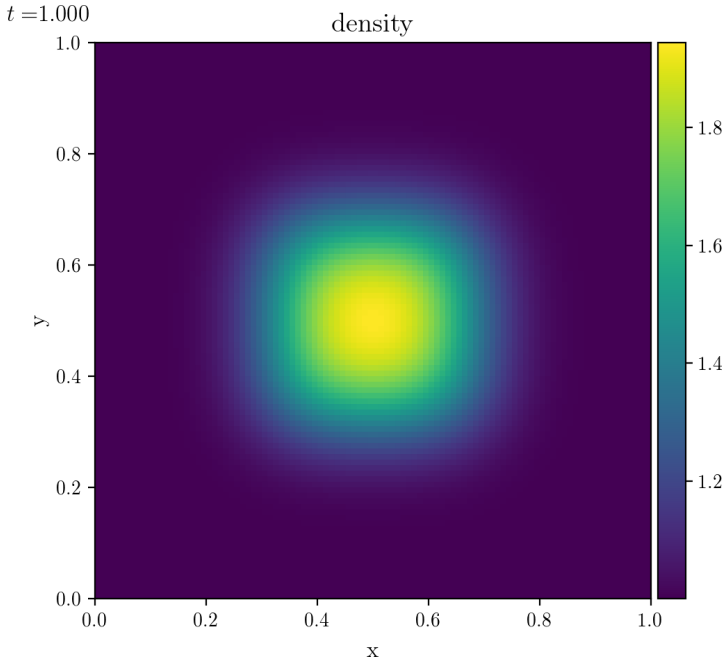
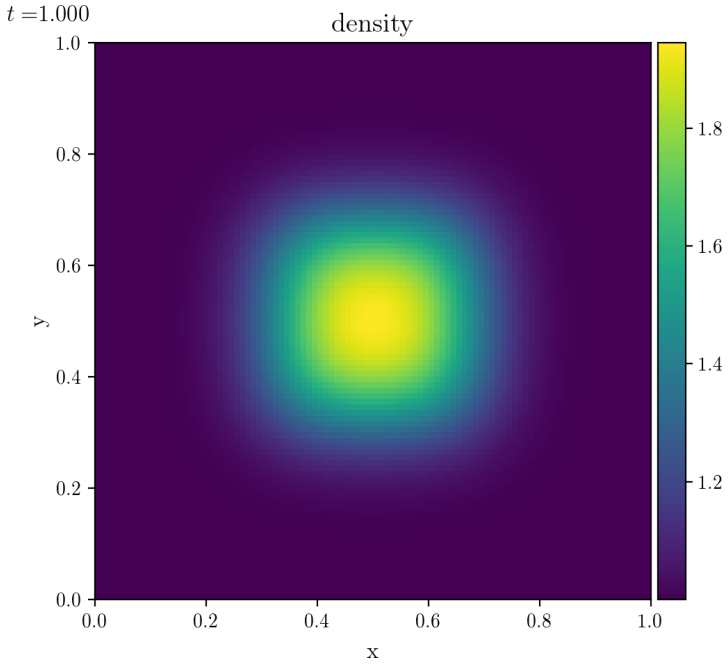


Figure 6: Obtained result 2D



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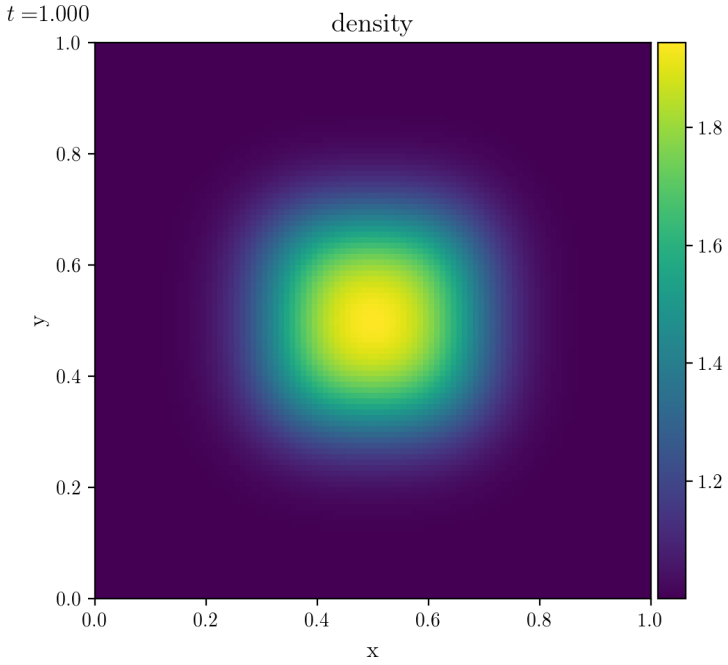
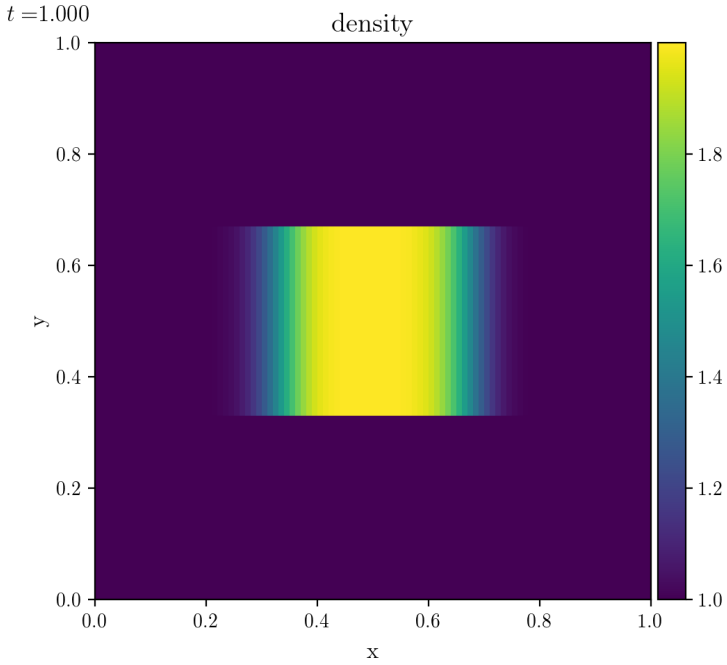


Figure 8: Obtained result 2D negative velocity



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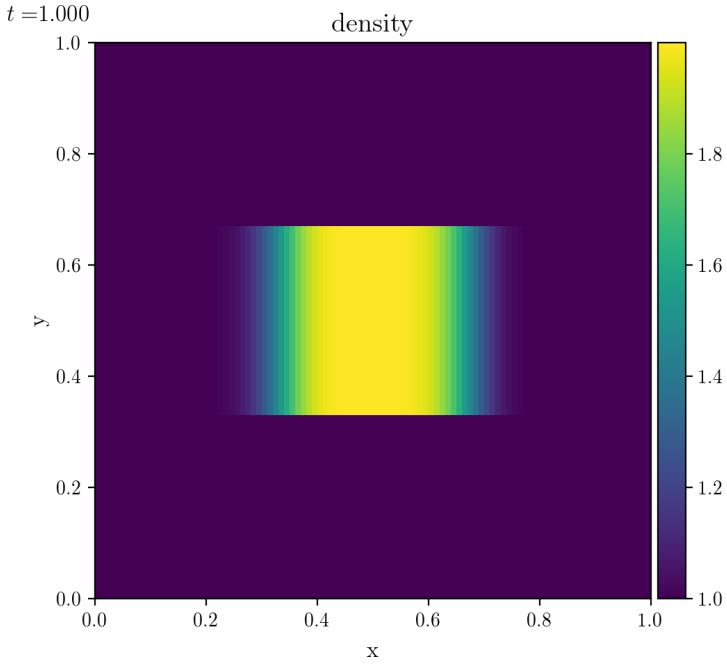
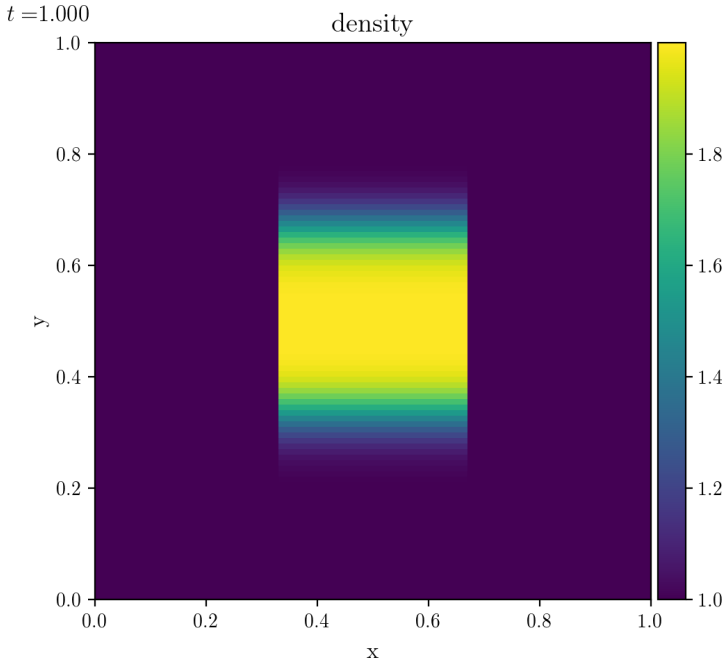


Figure 10: Obtained result 2D velocity in x direction only



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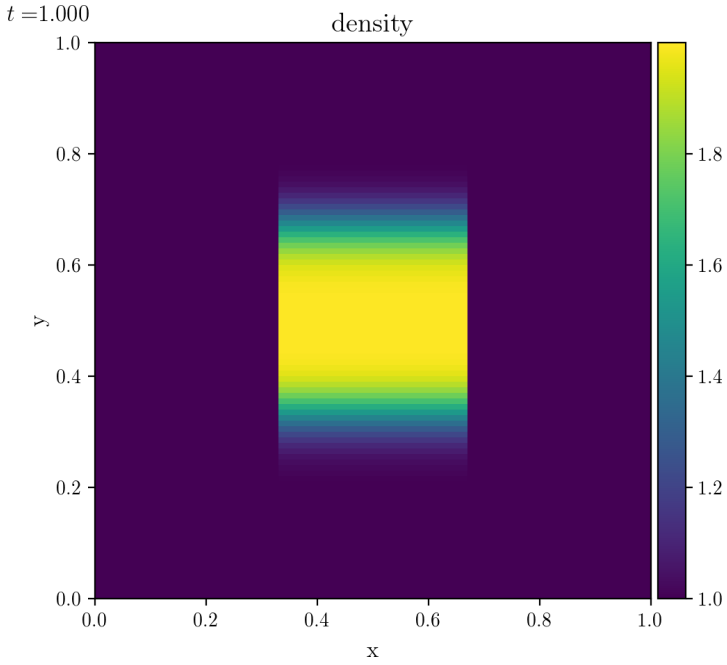
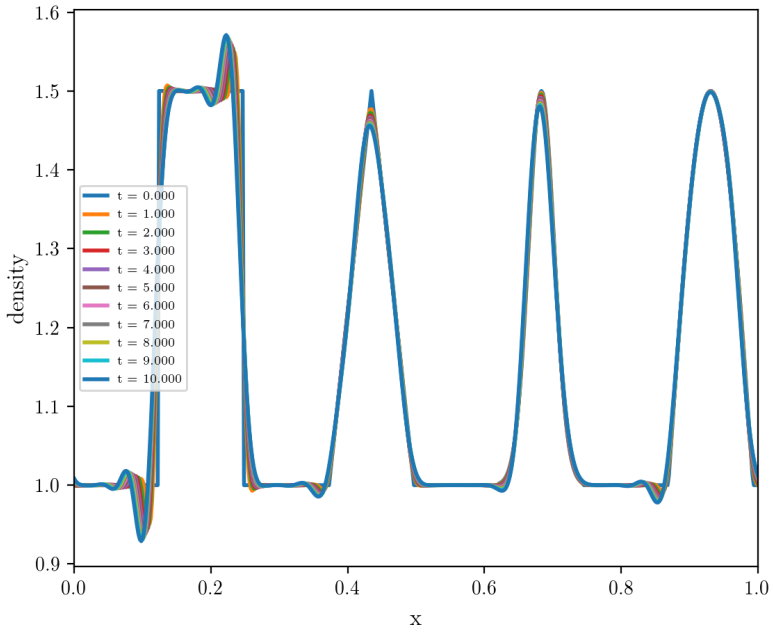


Figure 12: Obtained result 2D velocity in y direction only

1.2 Piecewise Linear



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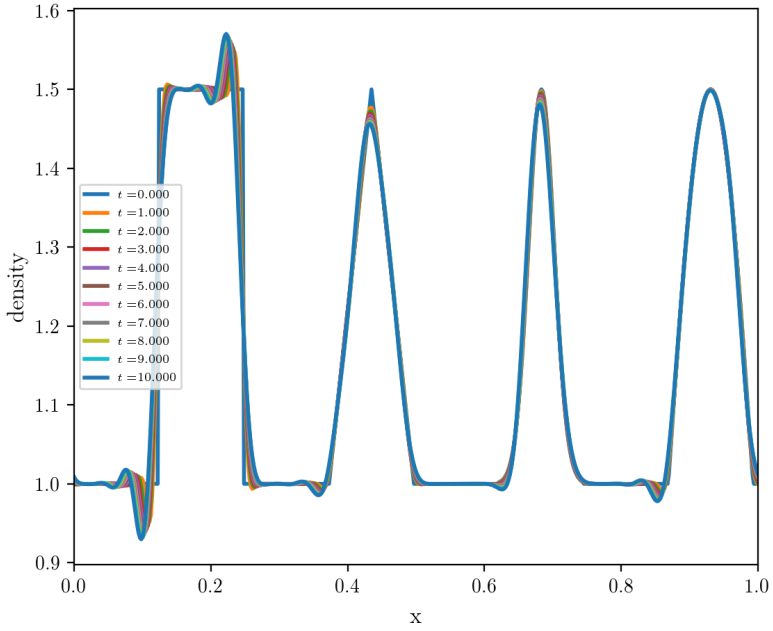

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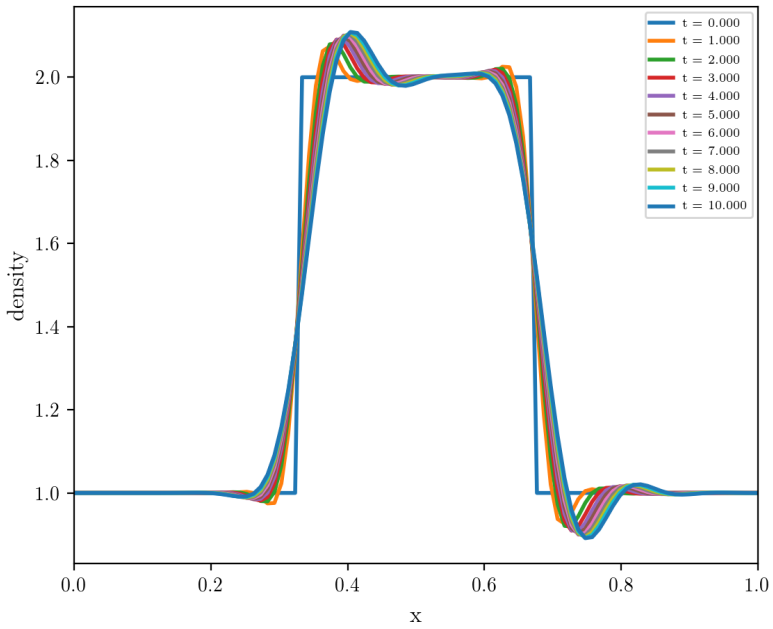
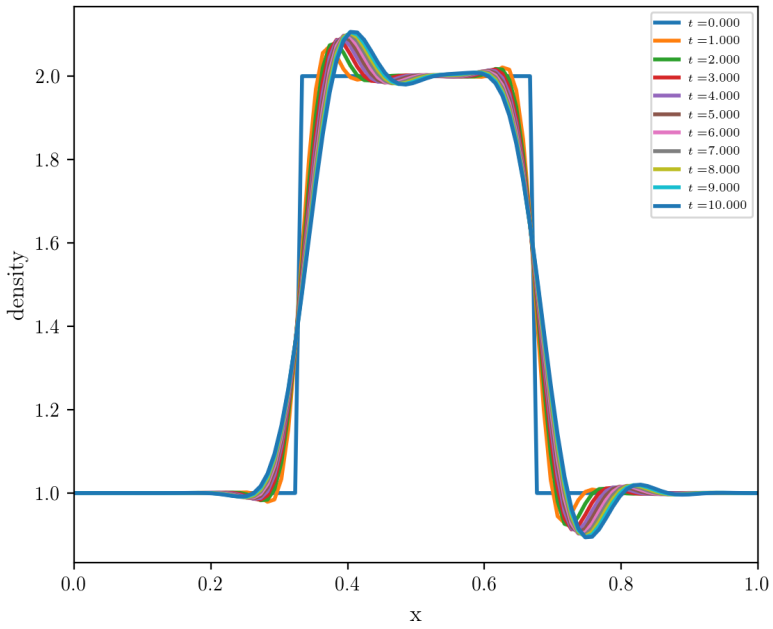


Figure 15: Expected result 1D negative velocity



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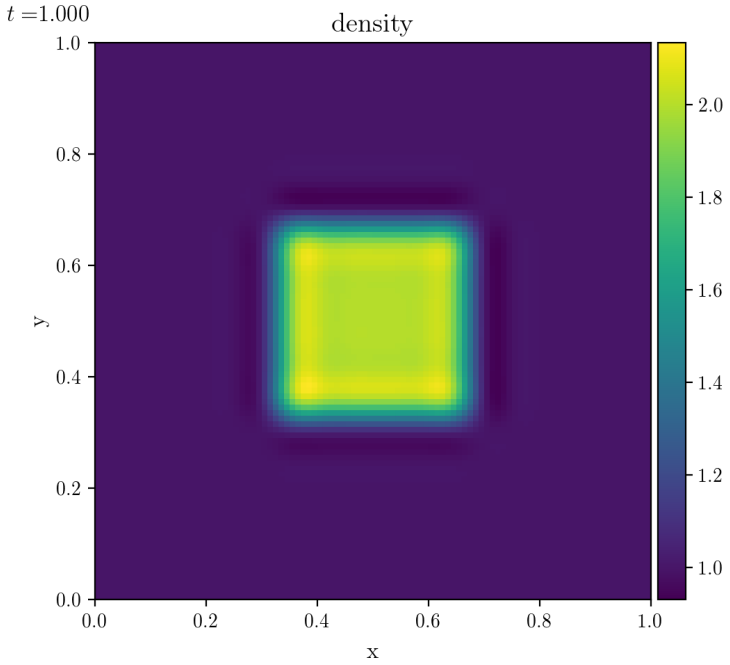

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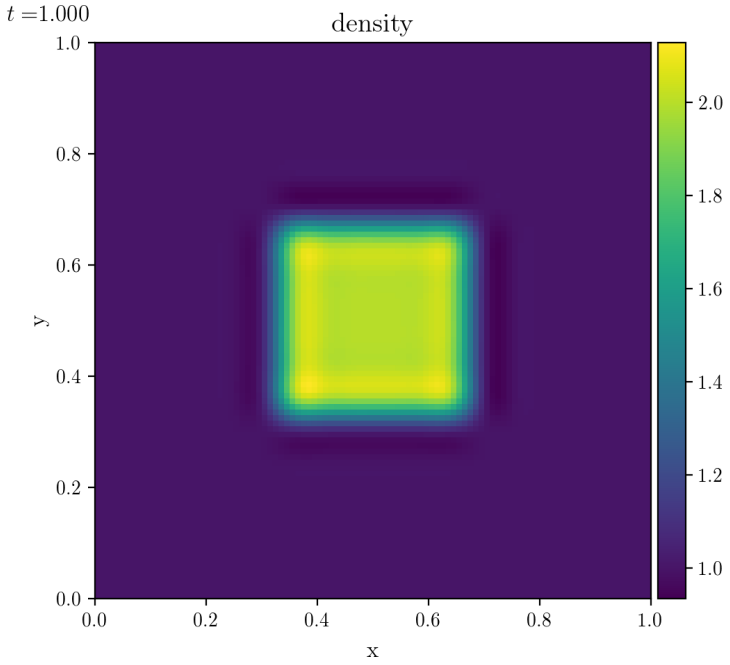

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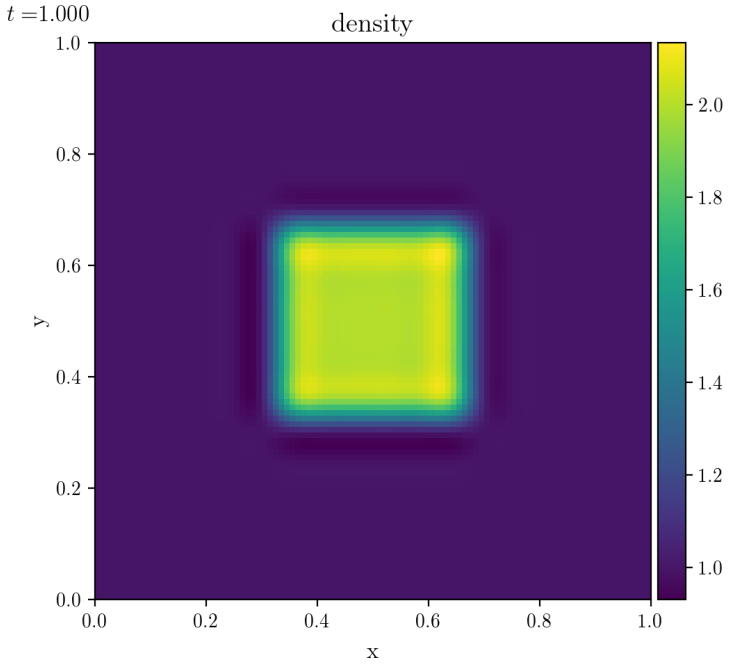

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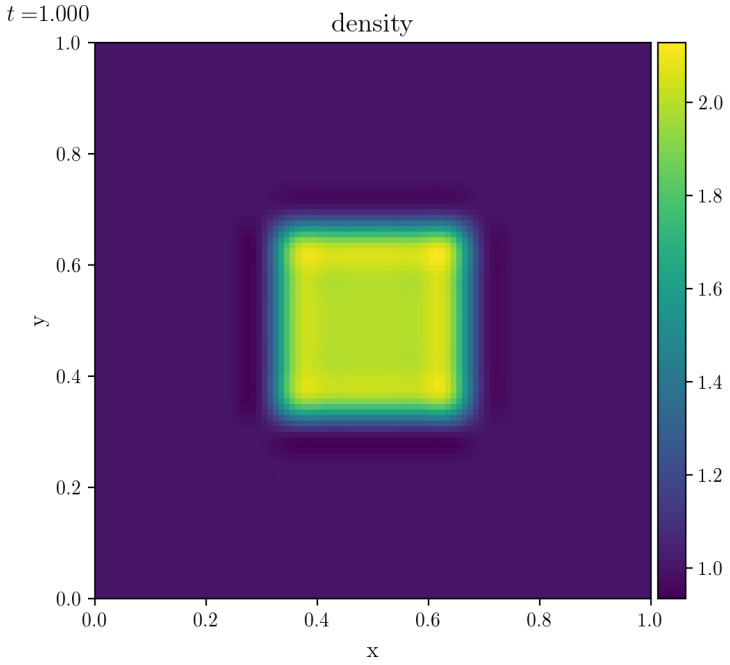

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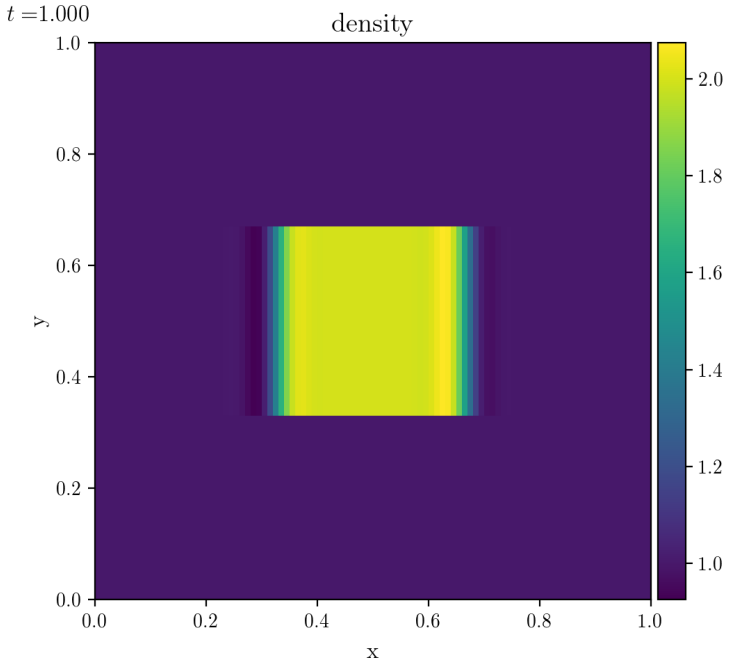

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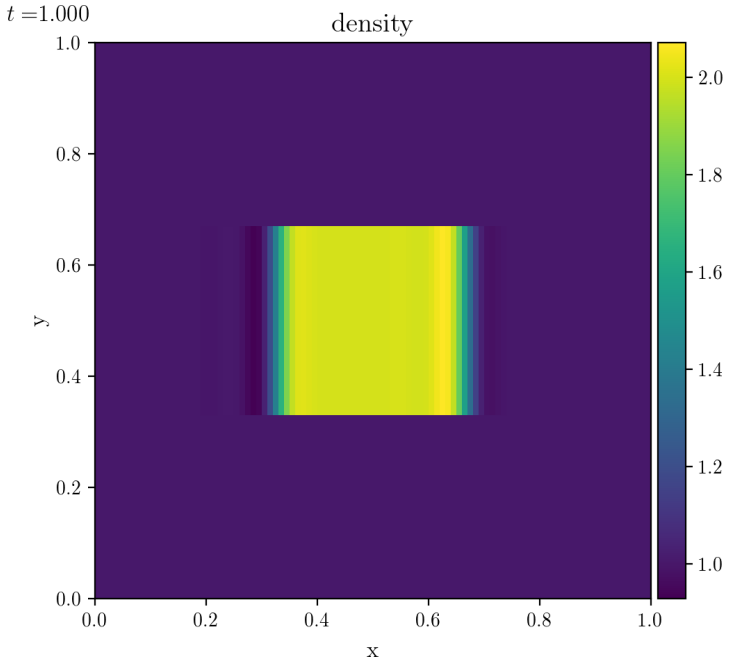


Figure 22: Obtained result 2D velocity in x direction only

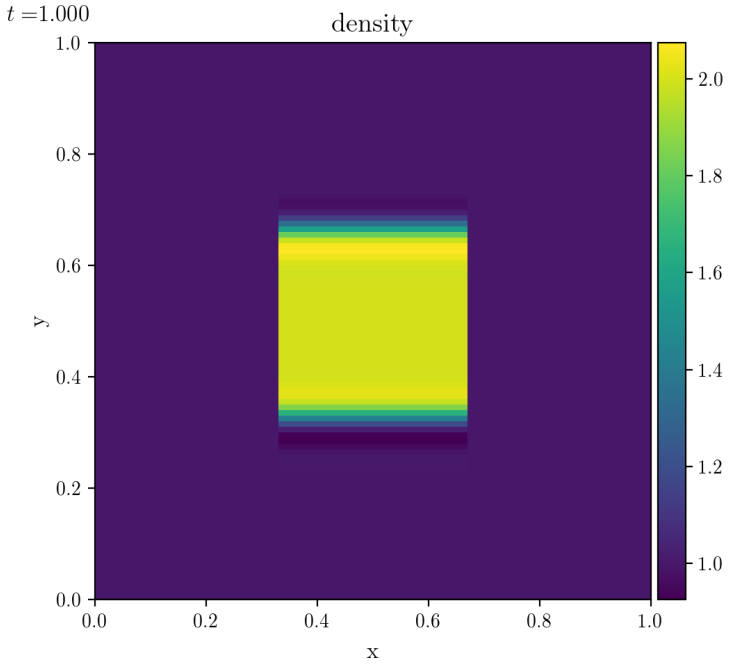
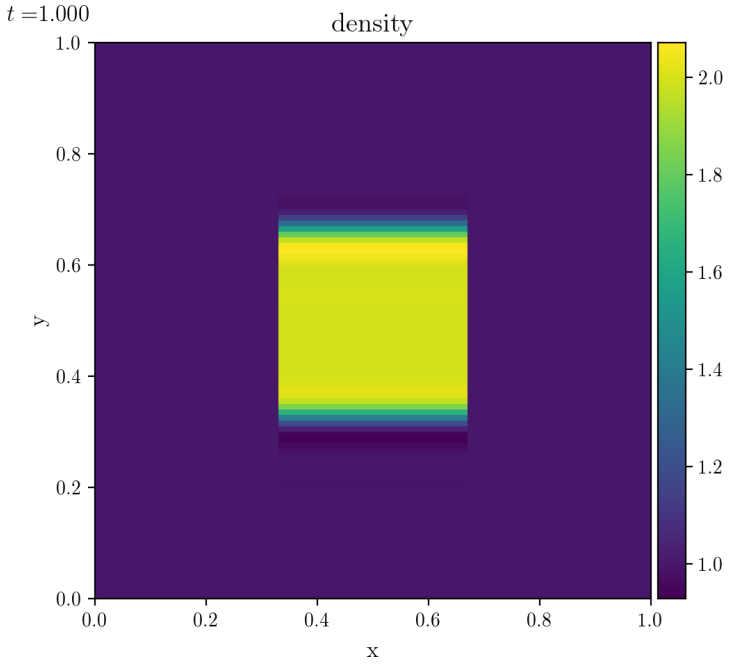


Figure 23: Expected result 2D velocity in y direction only



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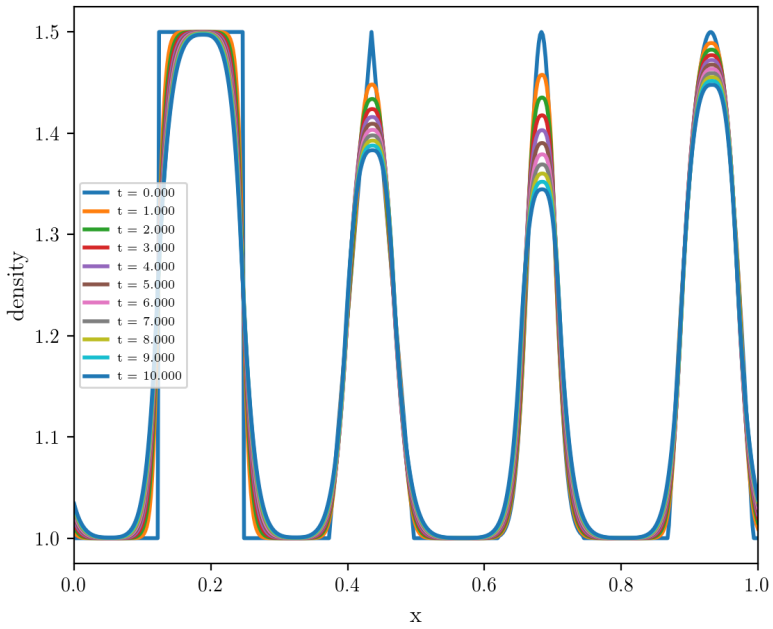
1.3 Piecewise Linear with Slope Limiters



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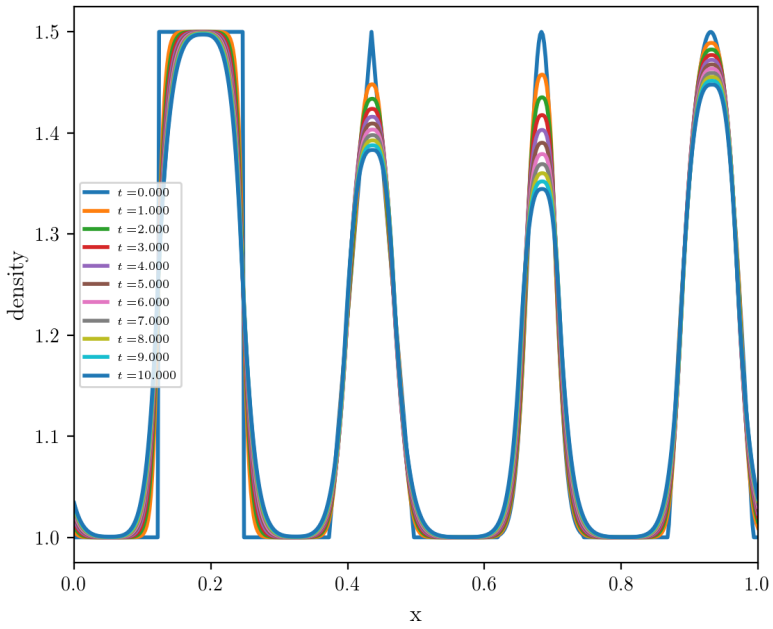

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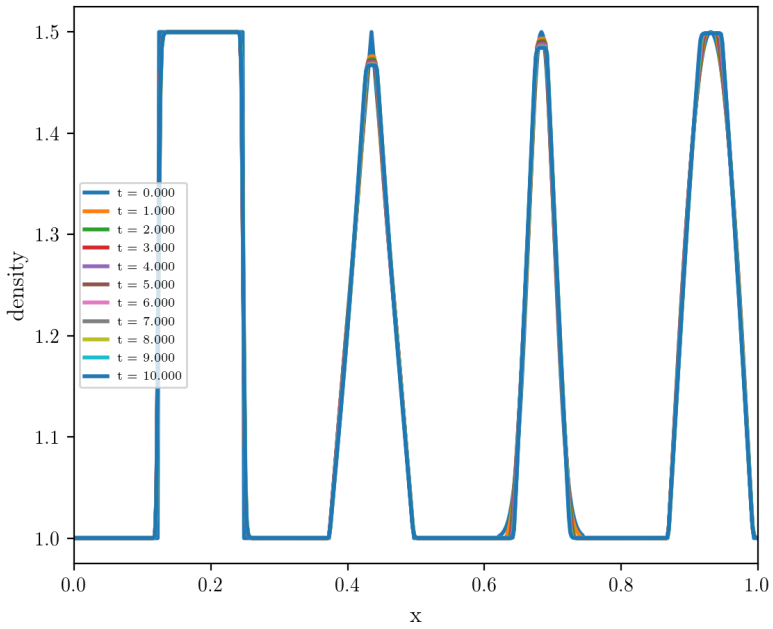
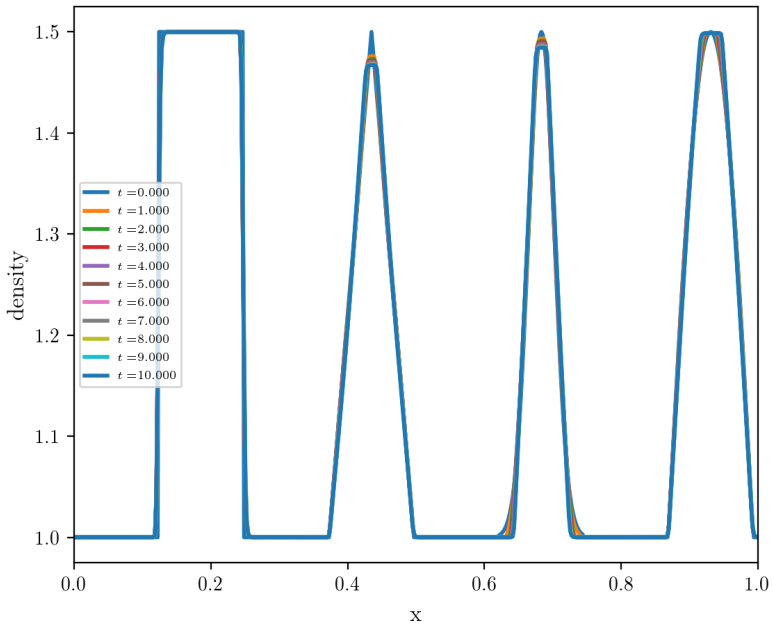


Figure 27: Superbee slope limiter. Expected result 1D negative velocity



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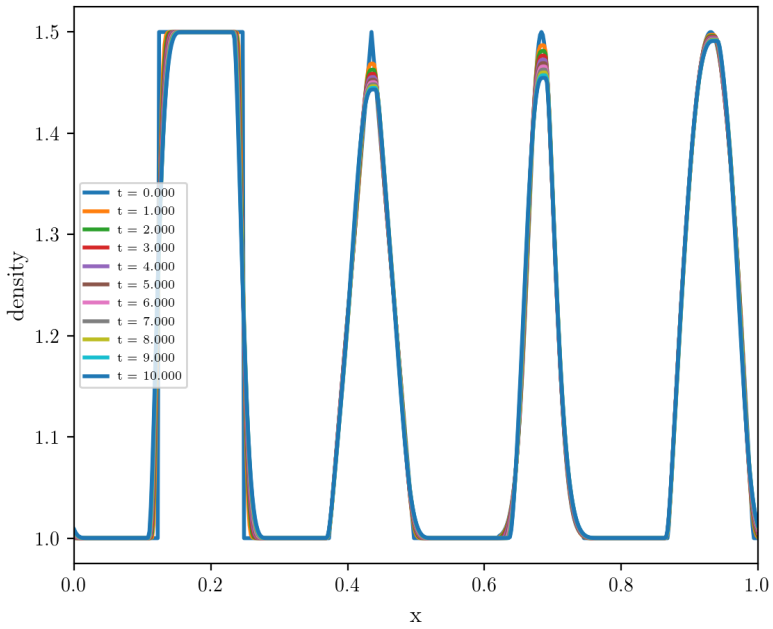
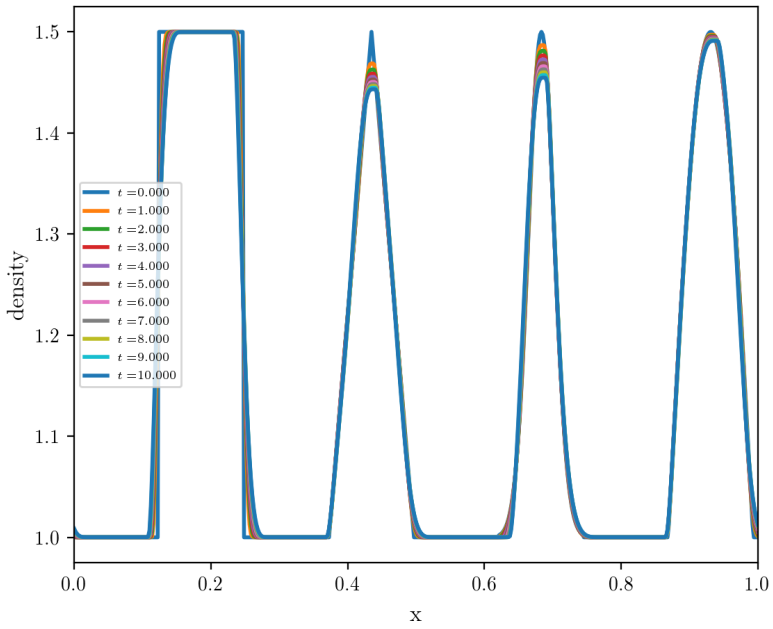


Figure 29: Monotonized central limiter. Expected result 1D



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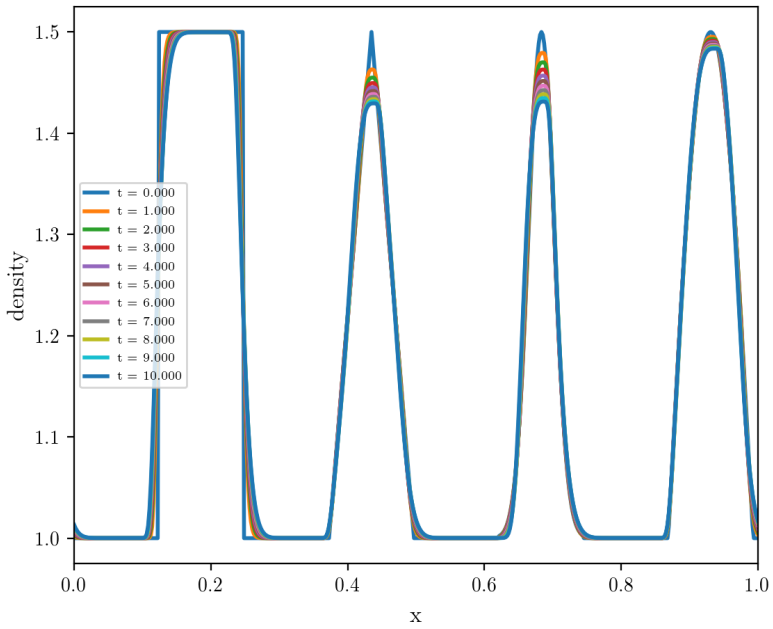
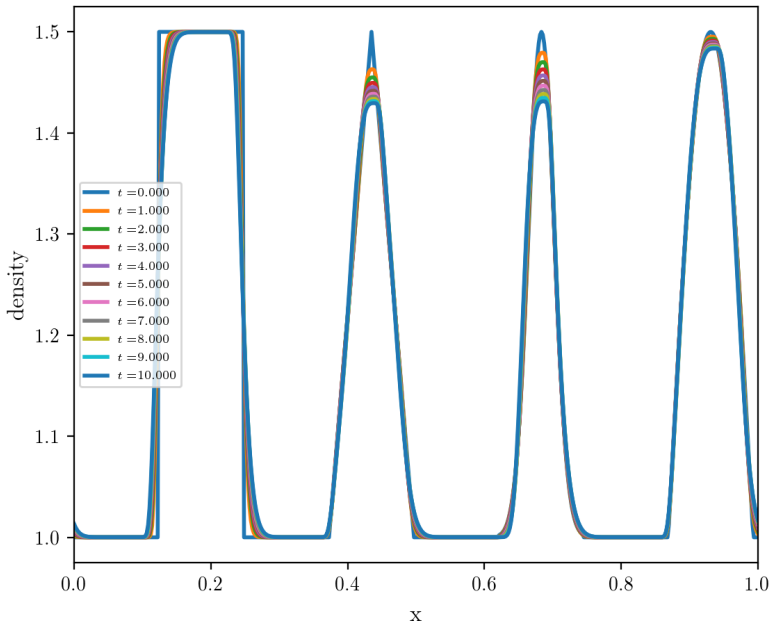


Figure 31: Van Leer Limiter. Expected result 1D



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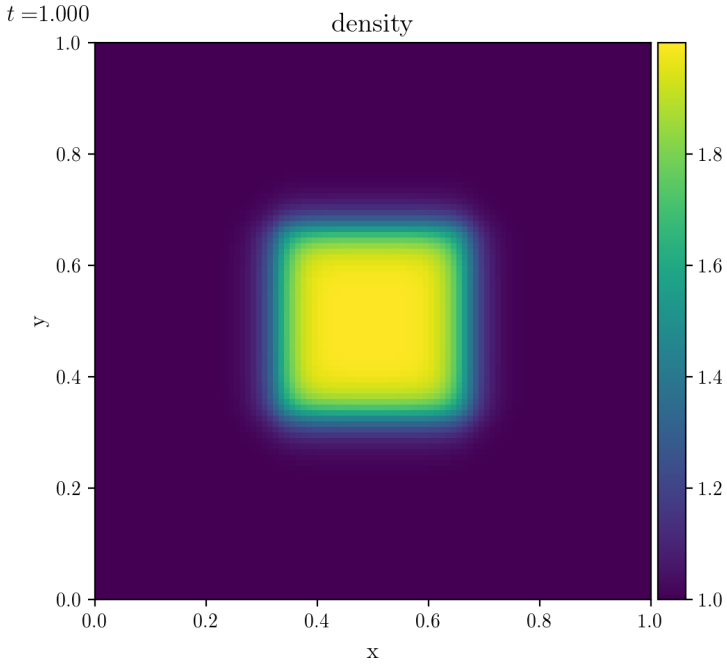

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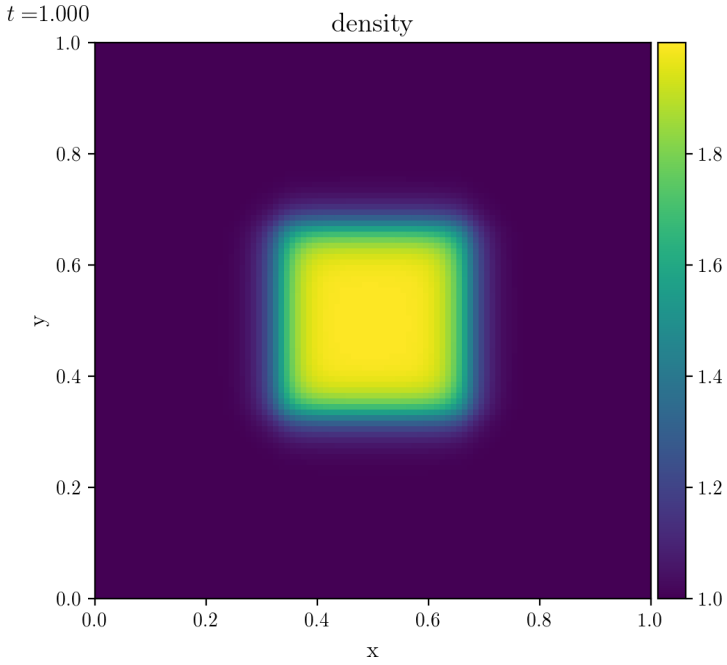

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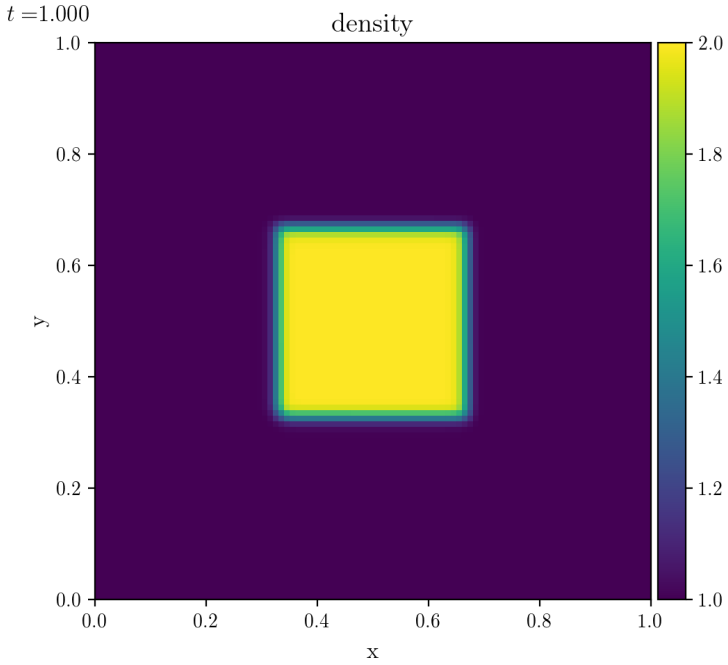
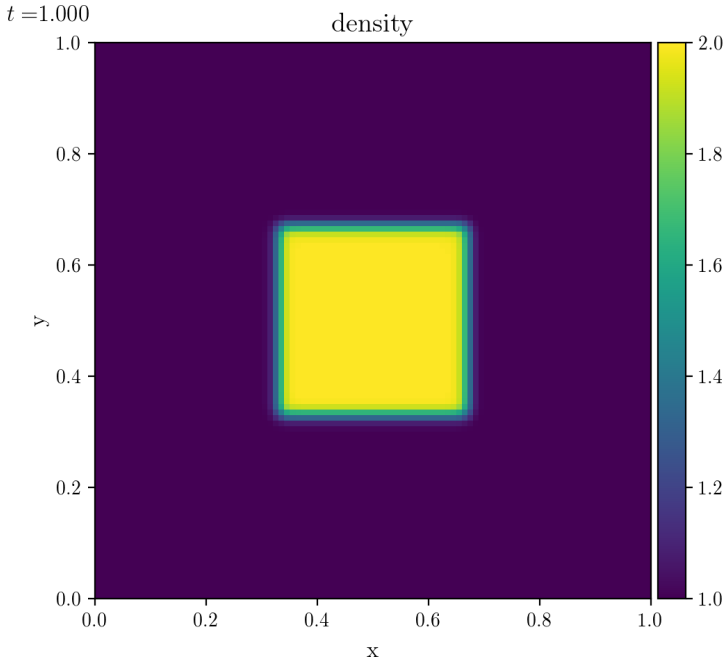


Figure 35: Superbee slope limiter. Expected result 2D negative velocity



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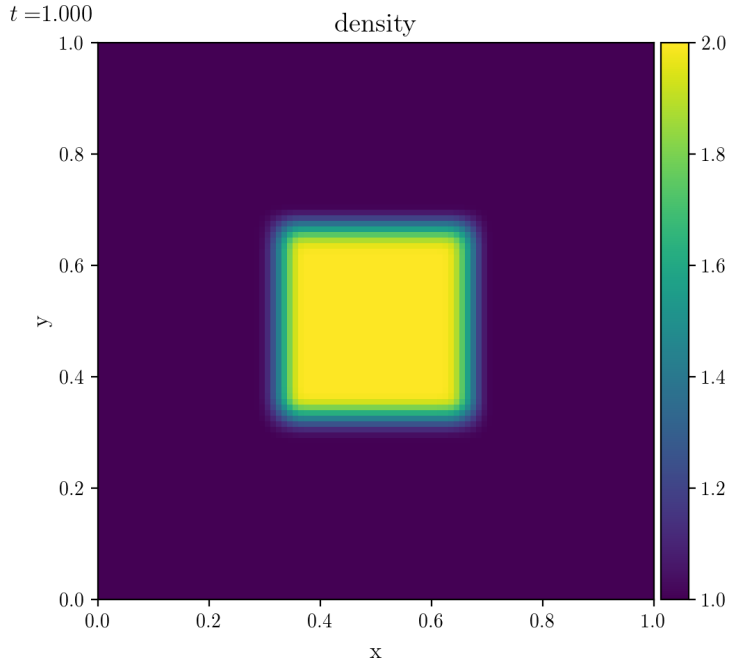

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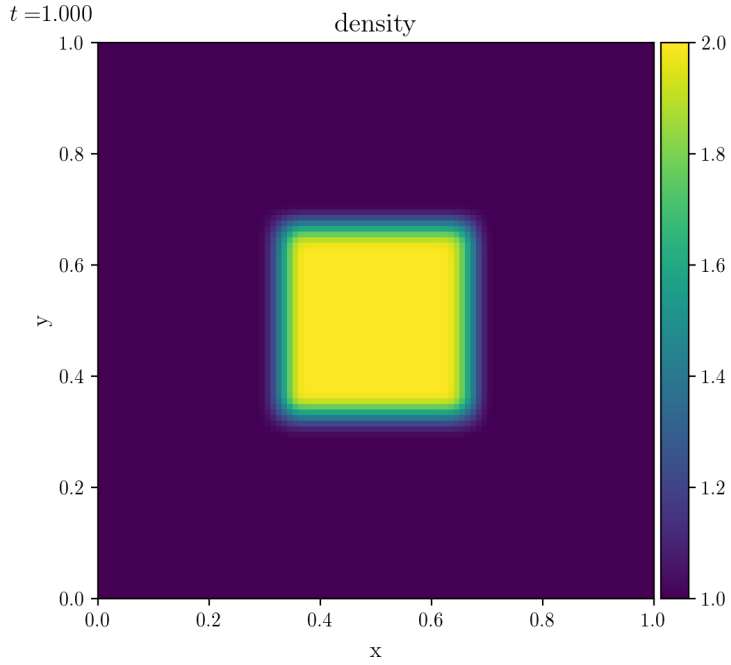
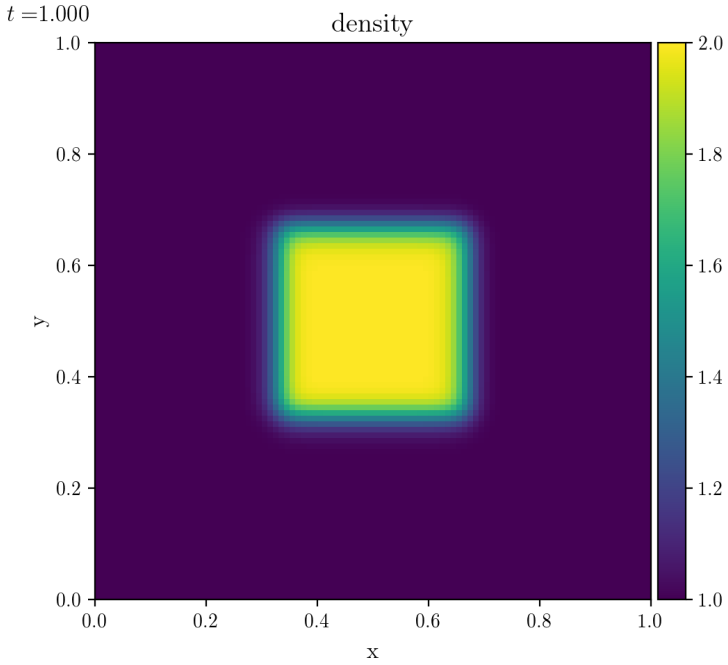


Figure 38: Monotonized central limiter. Obtained result 2D



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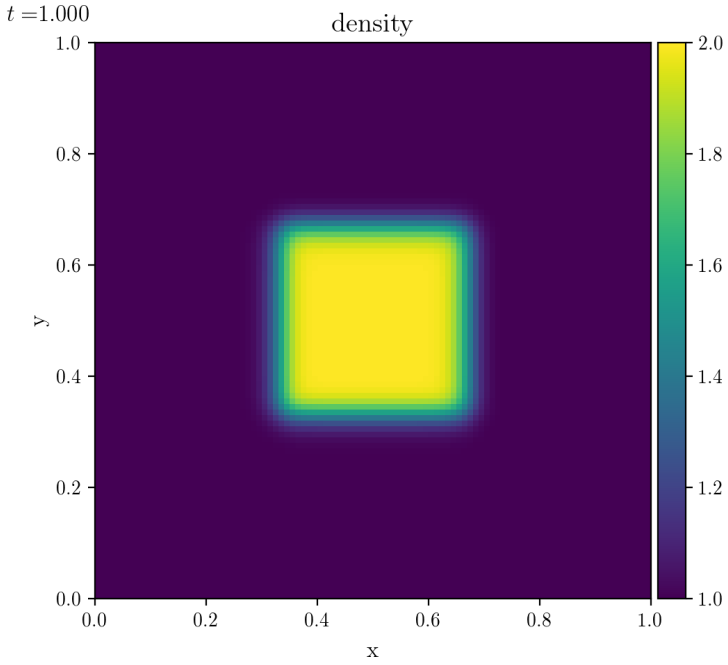
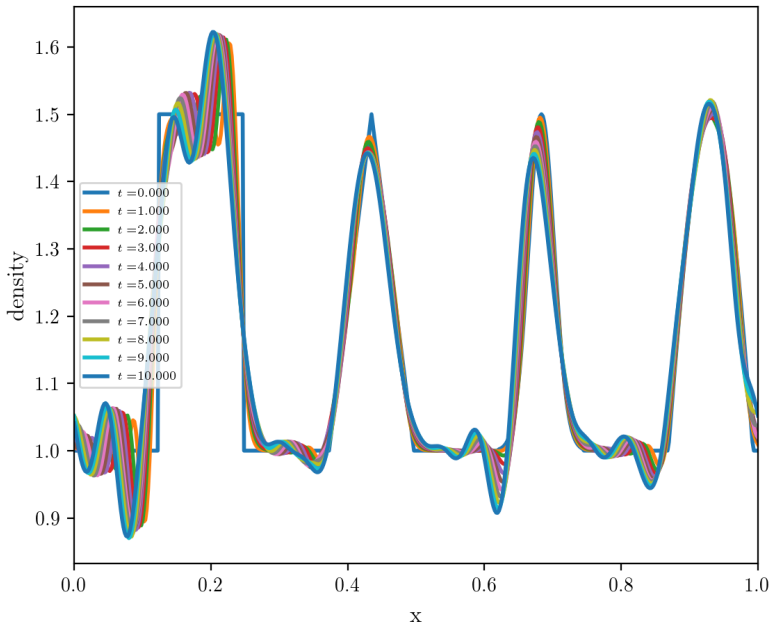


Figure 40: Van Leer Limiter. Obtained result 2D

1.4 WAF



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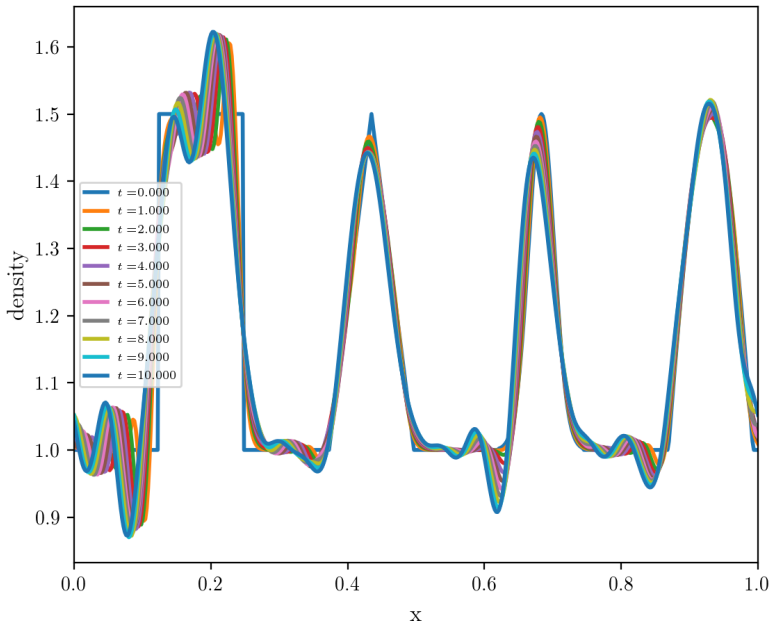

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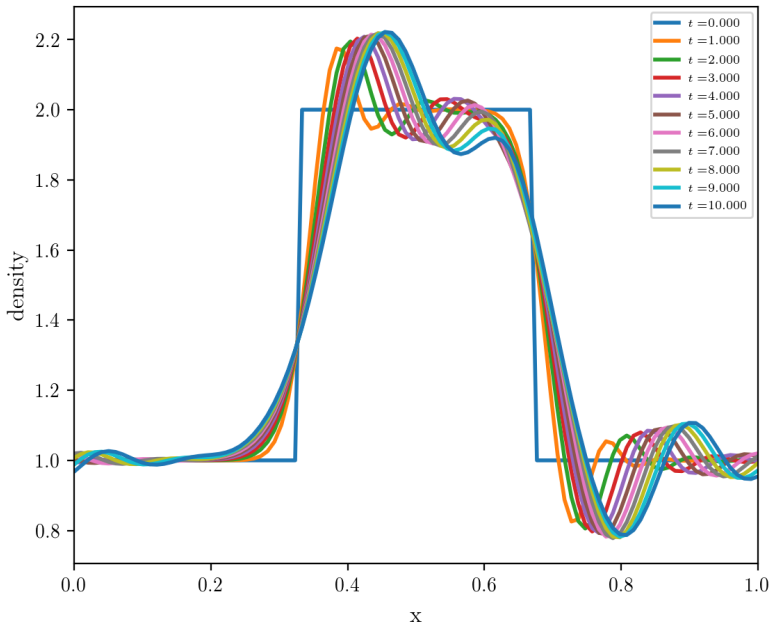

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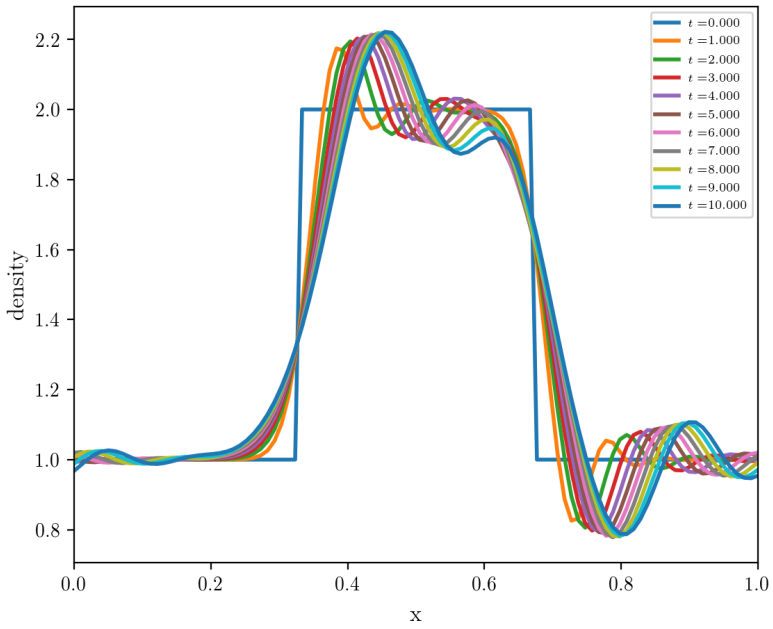

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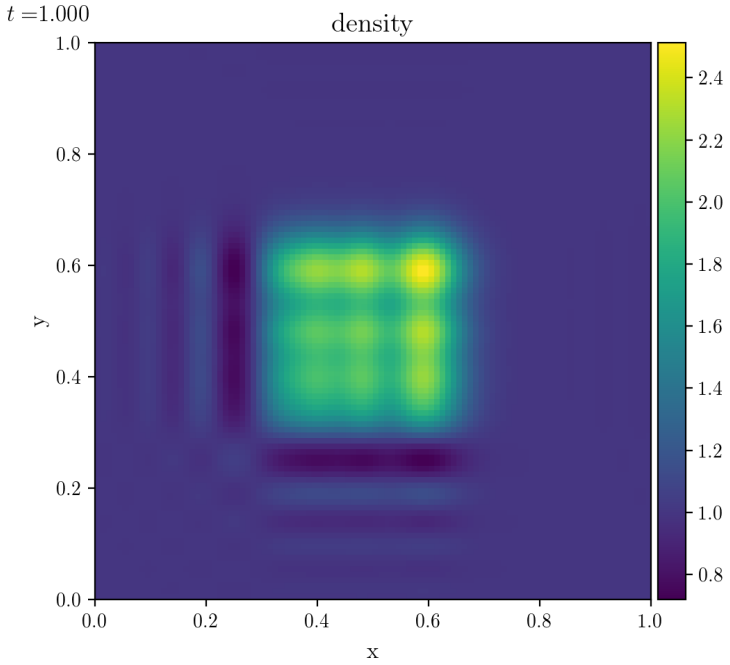

Figure 45: Expected result 2D

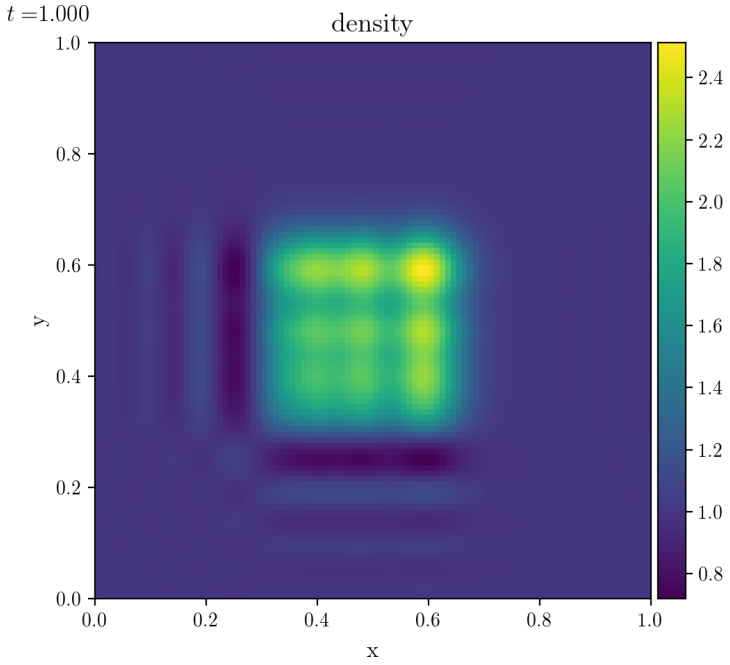

Figure 46: Obtained result 2D

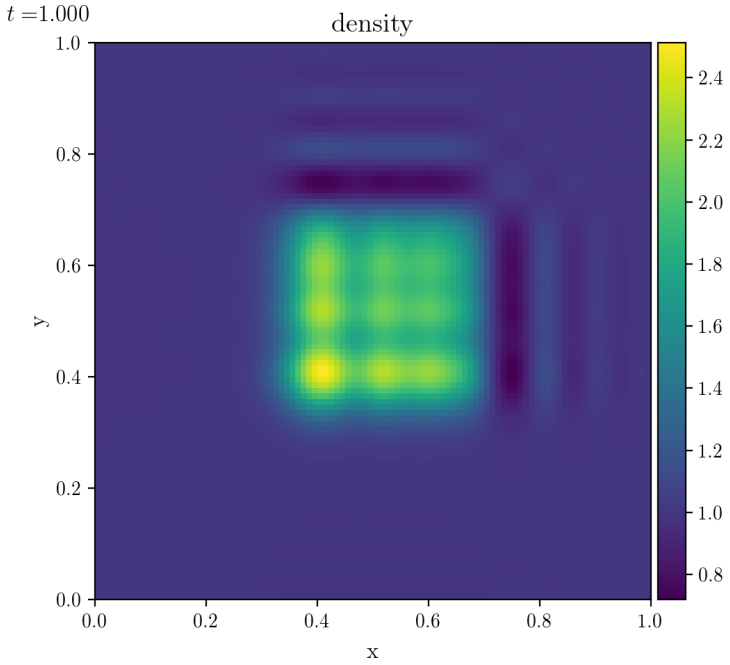

Figure 47: Expected result 2D negative velocity

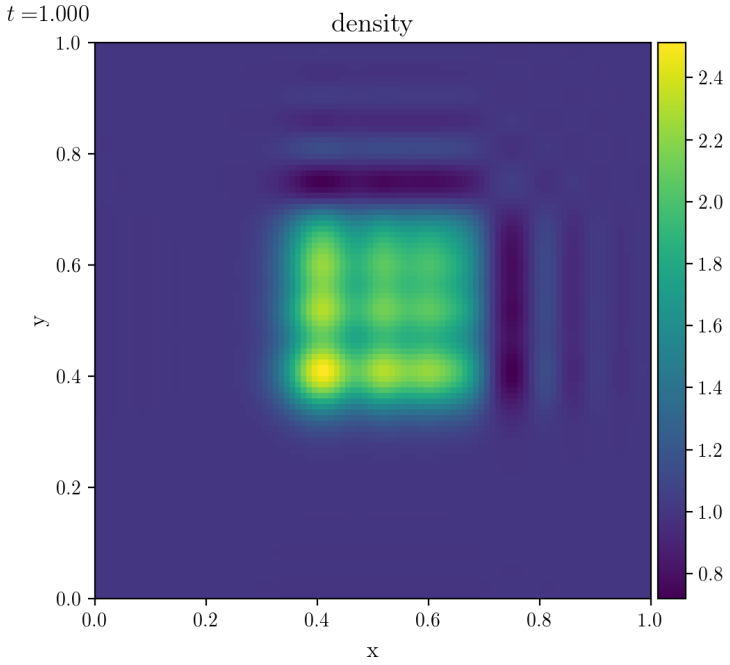

Figure 48: Obtained result 2D negative velocity

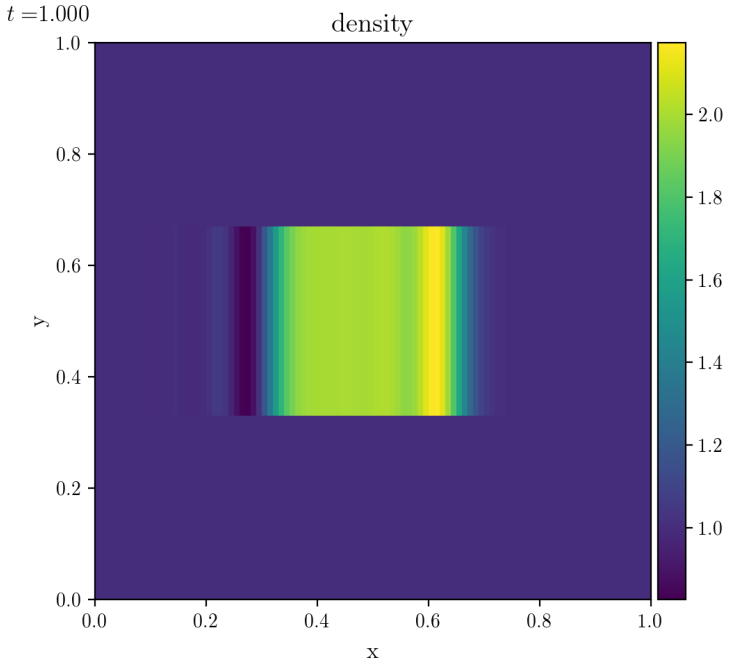

Figure 49: Expected result 2D velocity in x direction only

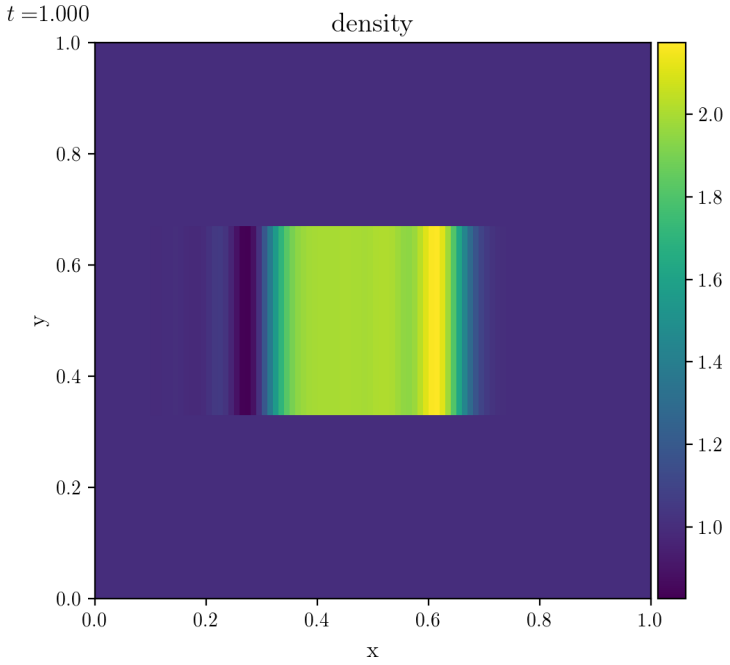

Figure 50: Obtained result 2D velocity in x direction only

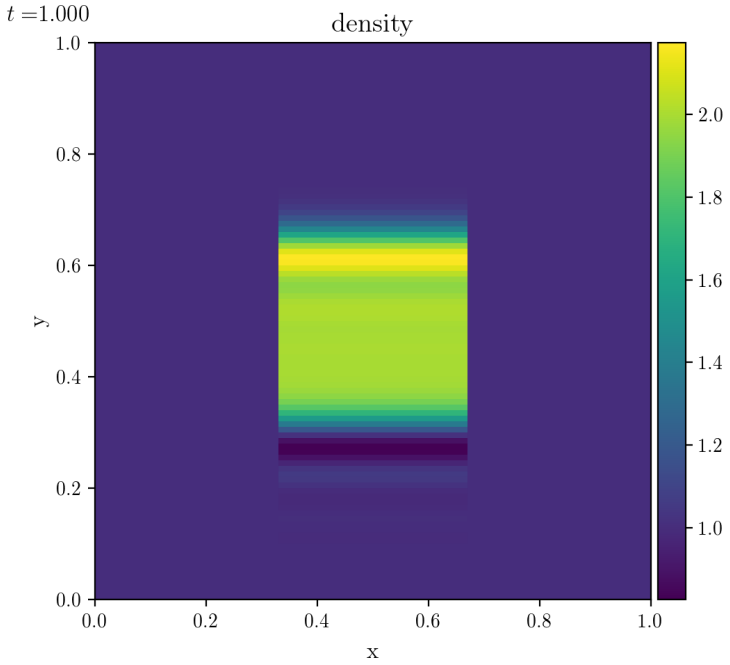

Figure 51: Expected result 2D velocity in y direction only

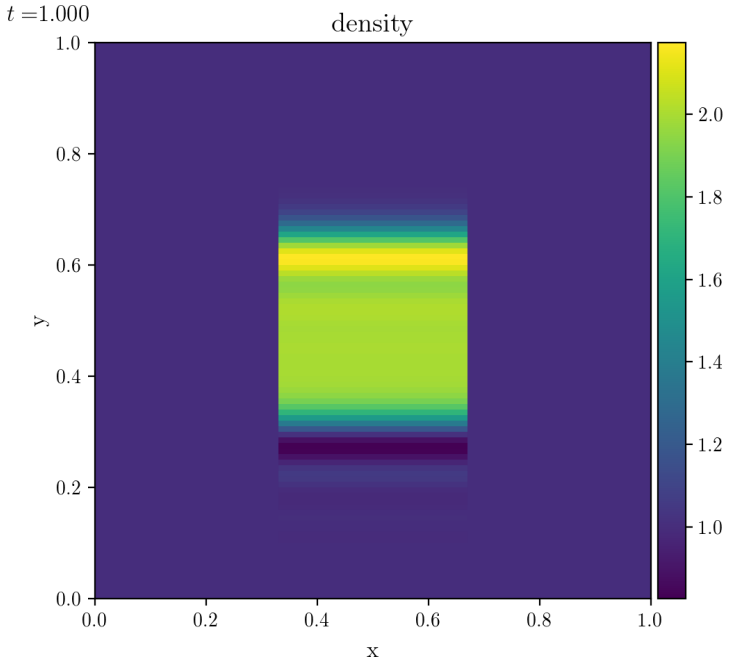

Figure 52: Obtained result 2D velocity in y direction only

1.5 WAF with Slope Limiters

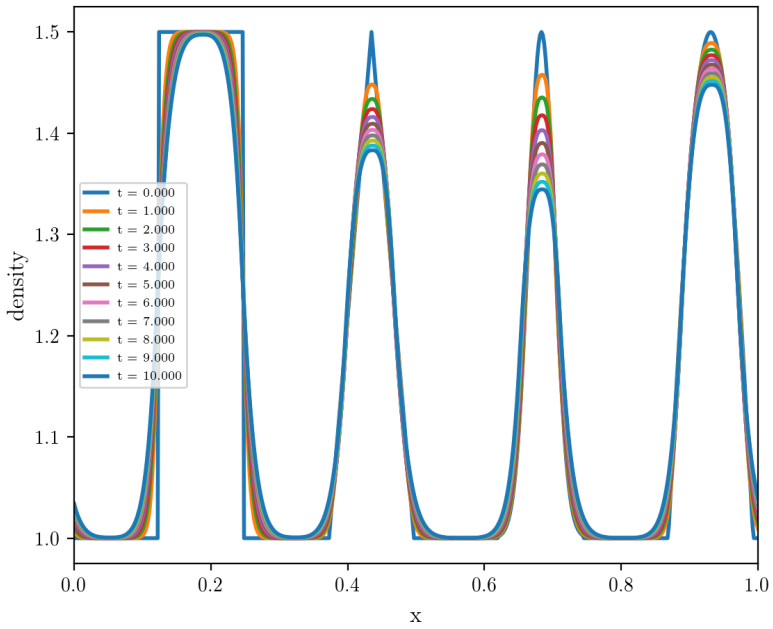

Figure 53: Minmod Slope Limiter. Expected result 1D

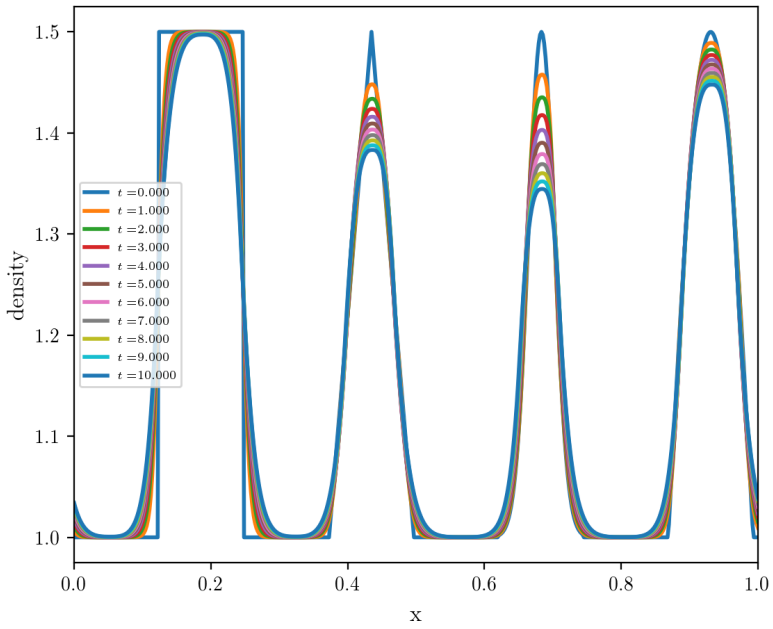

Figure 54: Minmod Slope Limiter. Obtained result 1D

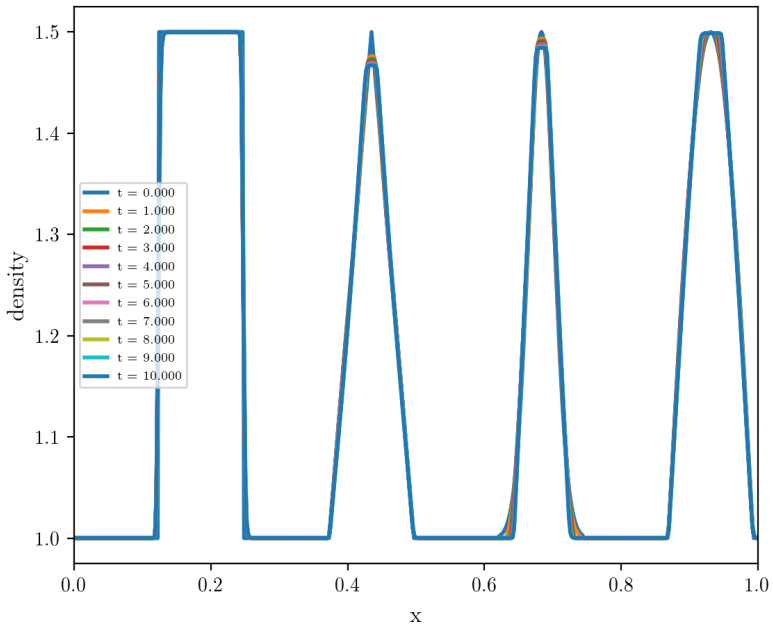

Figure 55: Superbee slope limiter. Expected result 1D negative velocity

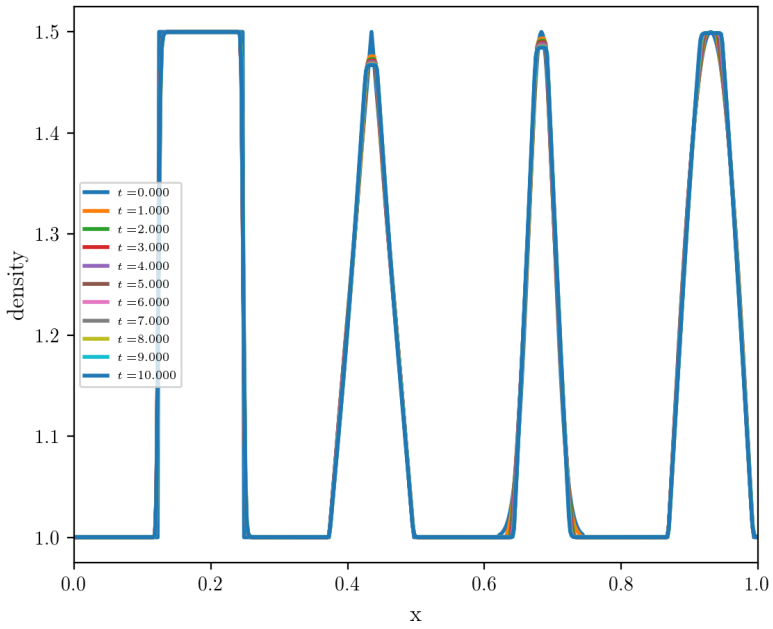

Figure 56: Superbee slope limiter. Obtained result 1D negative velocity

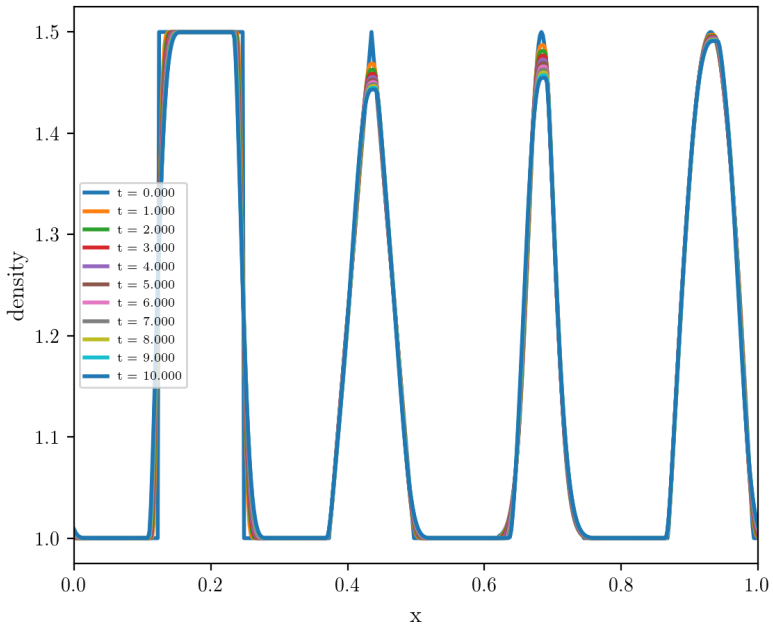

Figure 57: Monotonized central limiter. Expected result 1D

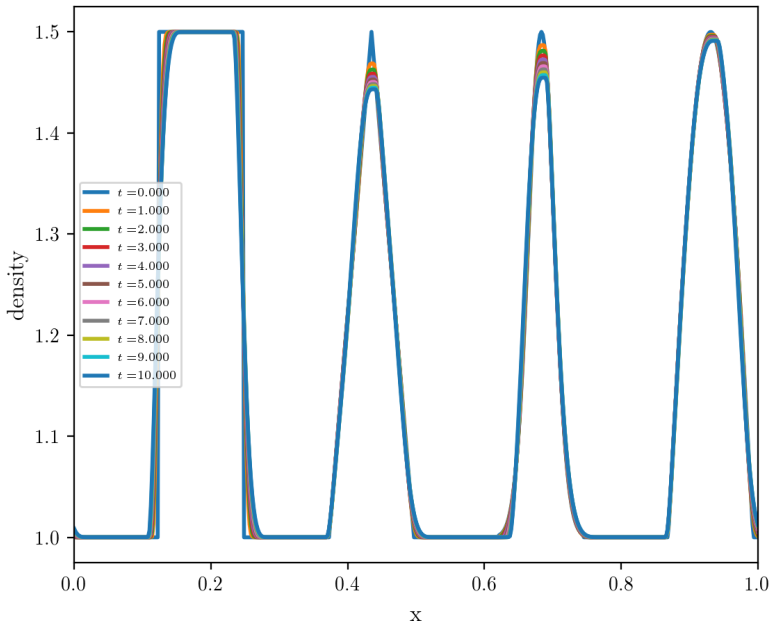

Figure 58: Monotonized central limiter. Obtained result 1D

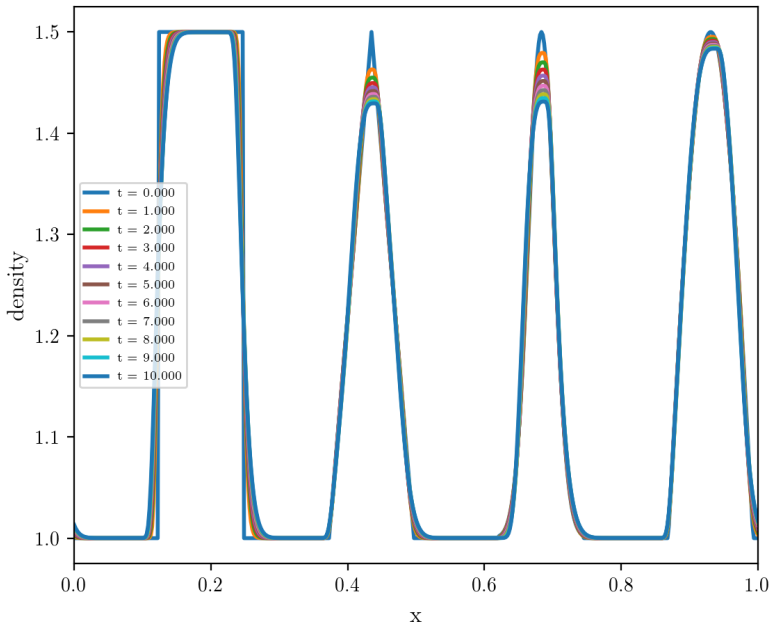

Figure 59: Van Leer Limiter. Expected result 1D

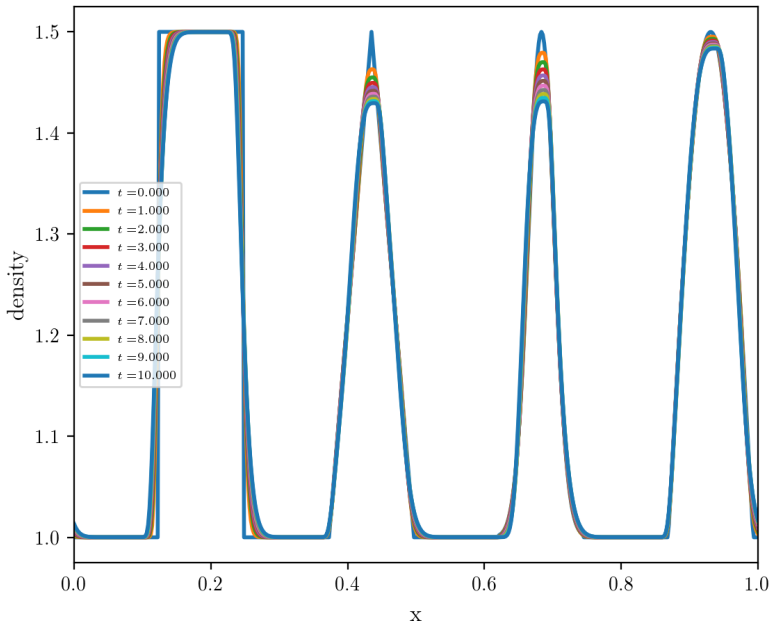

Figure 60: Van Leer Limiter. Obtained result 1D

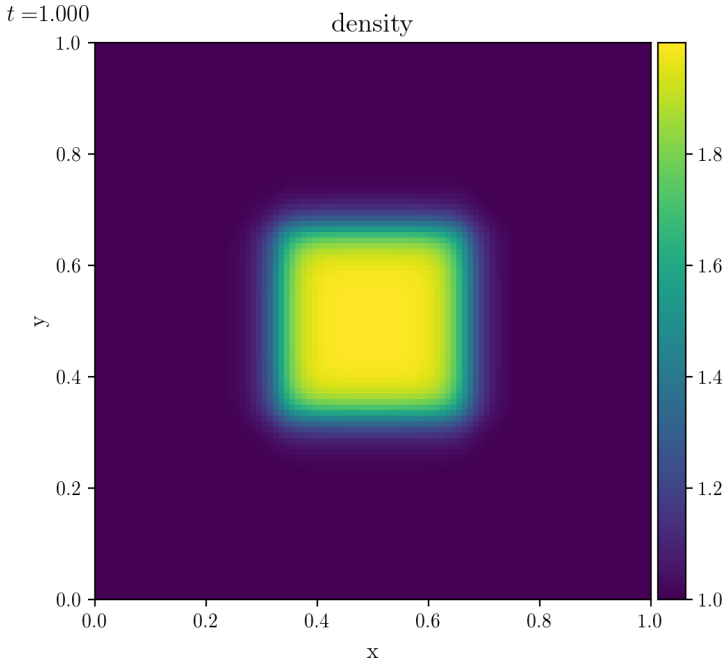

Figure 61: Minmod Slope Limiter. Expected result 2D

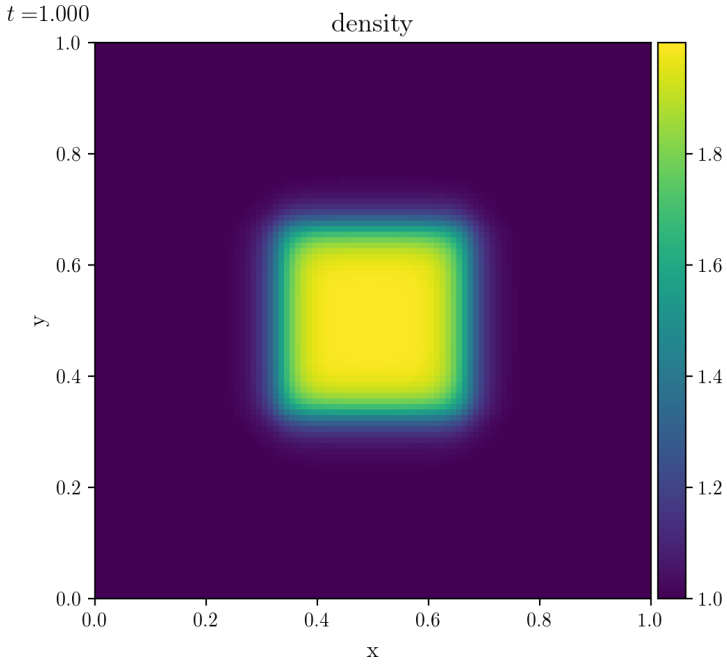

Figure 62: Minmod Slope Limiter. Obtained result 2D

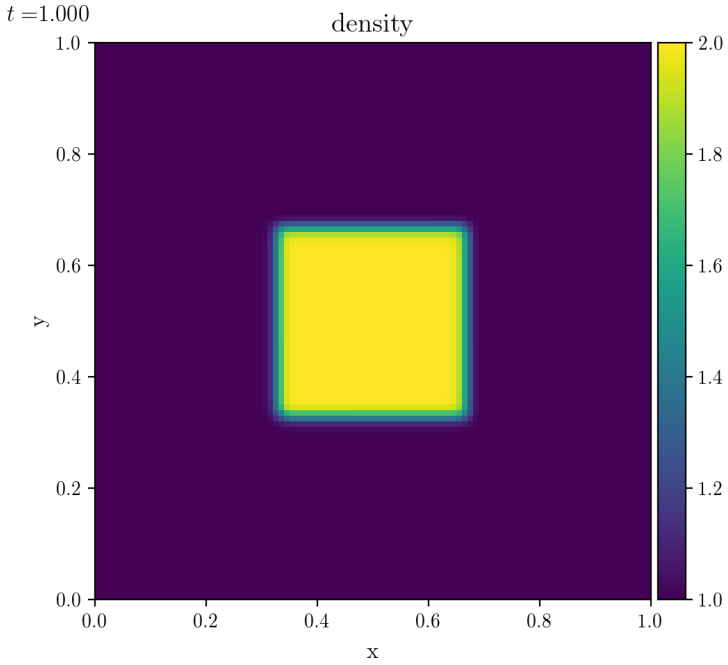

Figure 63: Superbee slope limiter. Expected result 2D negative velocity

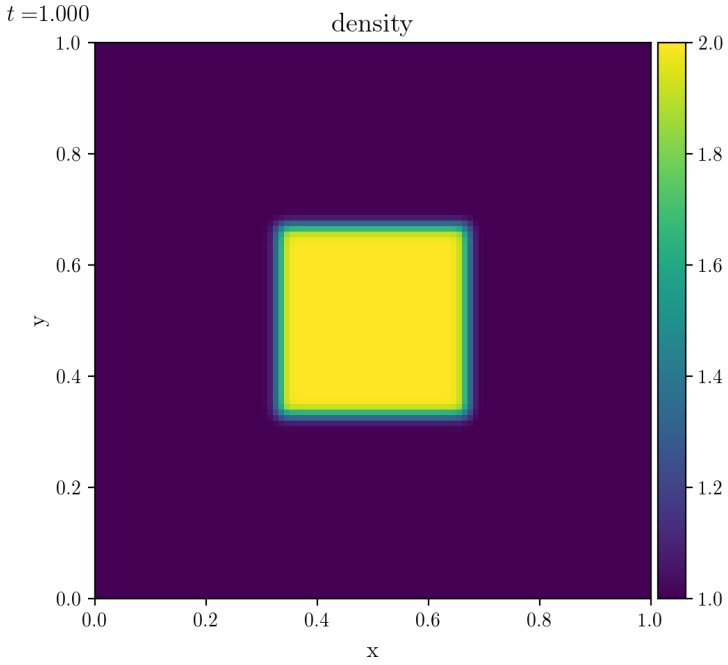

Figure 64: Superbee slope limiter. Obtained result 2D negative velocity

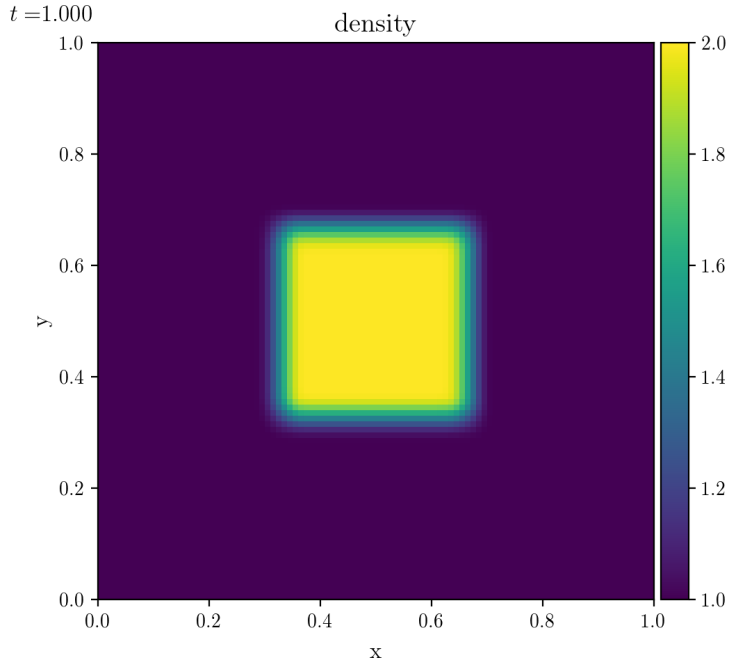

Figure 65: Monotonized central limiter. Expected result 2D

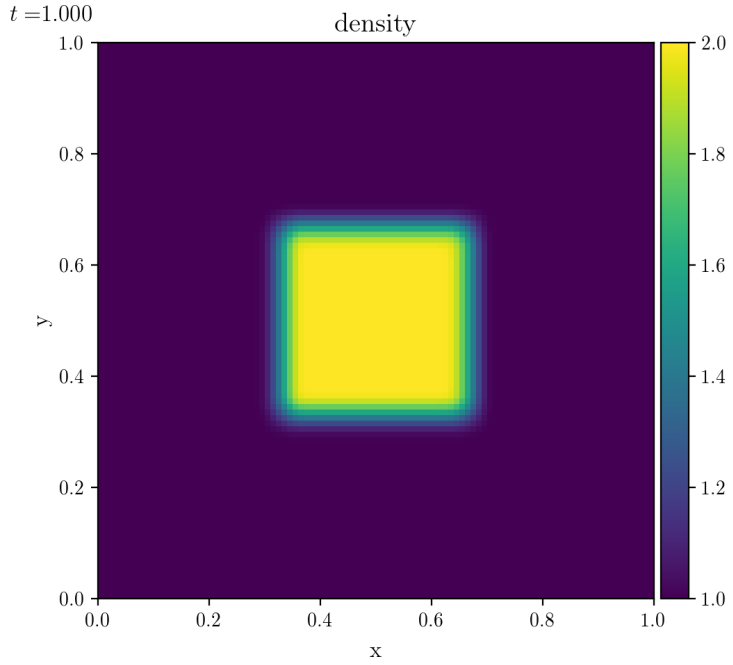

Figure 66: Monotonized central limiter. Obtained result 2D

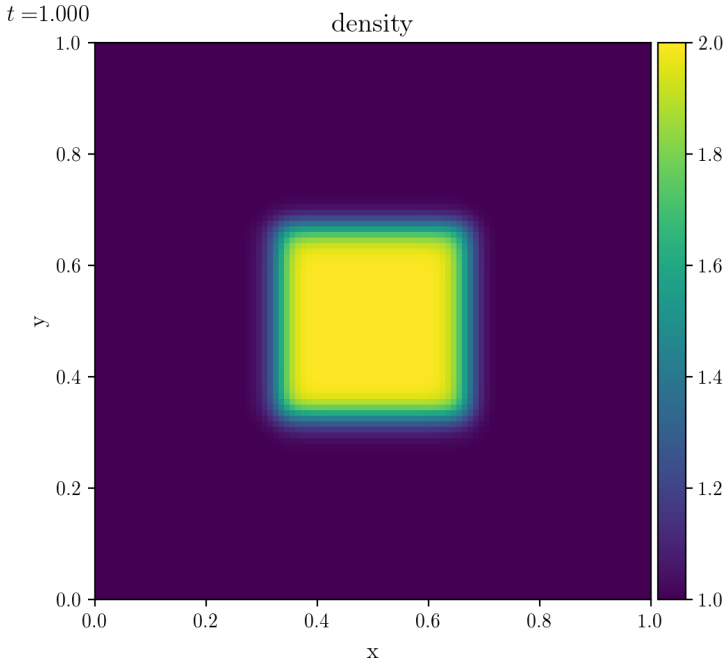

Figure 67: Van Leer Limiter. Expected result 2D

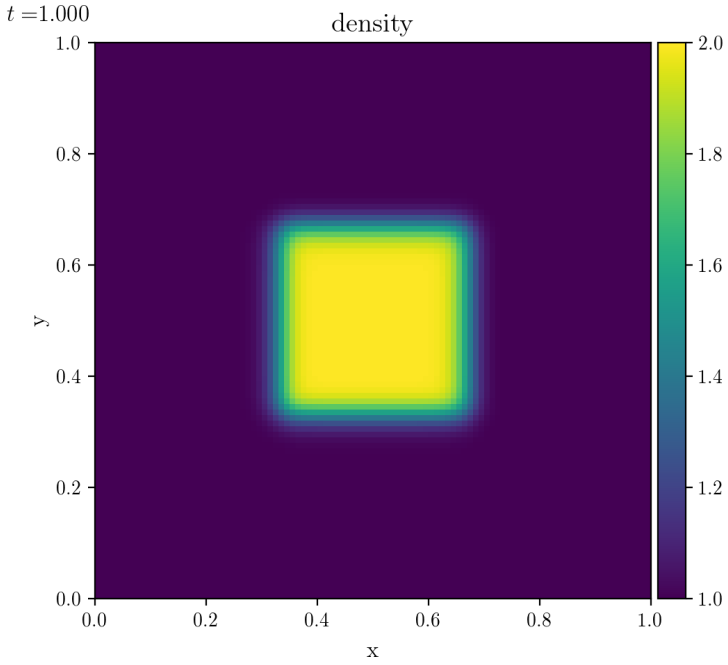

Figure 68: Van Leer Limiter. Obtained result 2D

2 Riemann Solvers

2.1 Exact vs Python

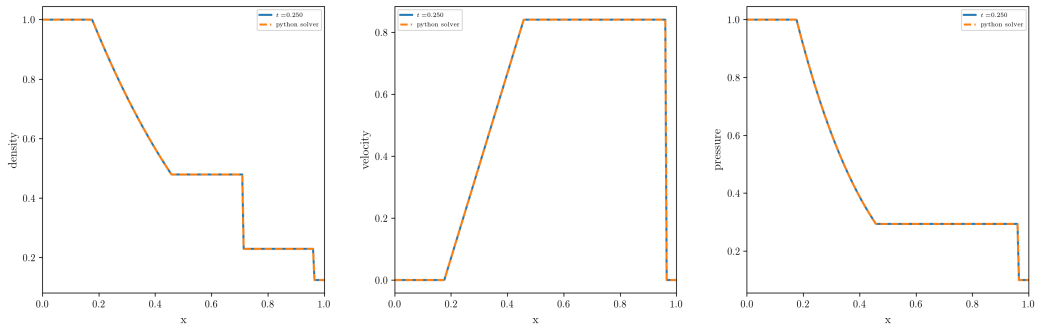

Figure 69: Exact solver for (right facing) sod shock. Expected result.

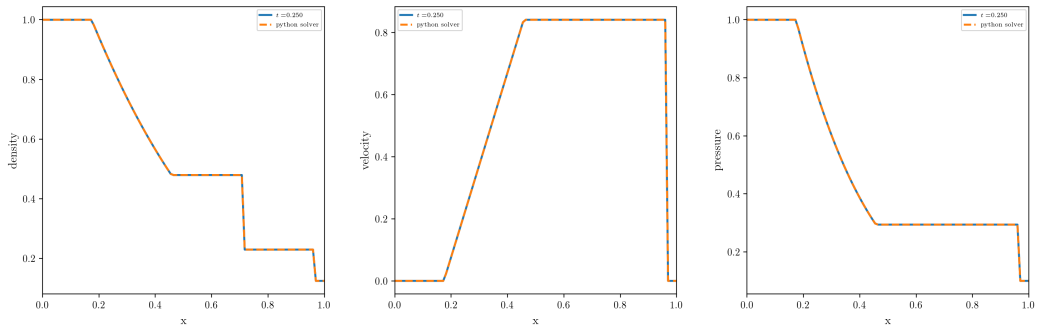

Figure 70: Exact solver for (right facing) sod shock. Obtained result.

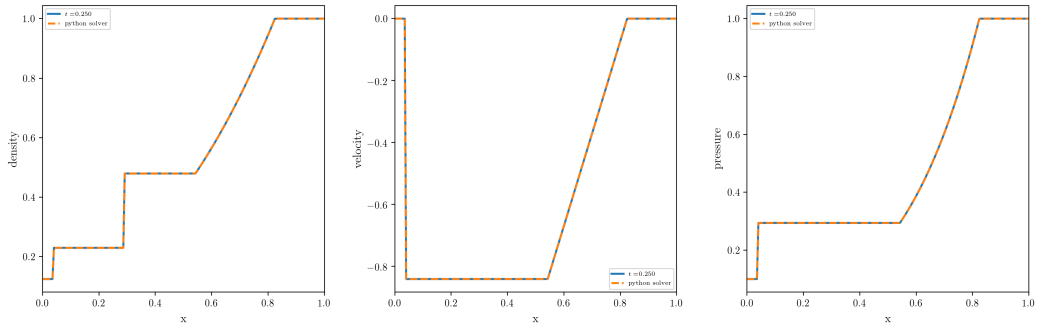

Figure 71: Exact solver for (left facing) sod shock. Expected result.

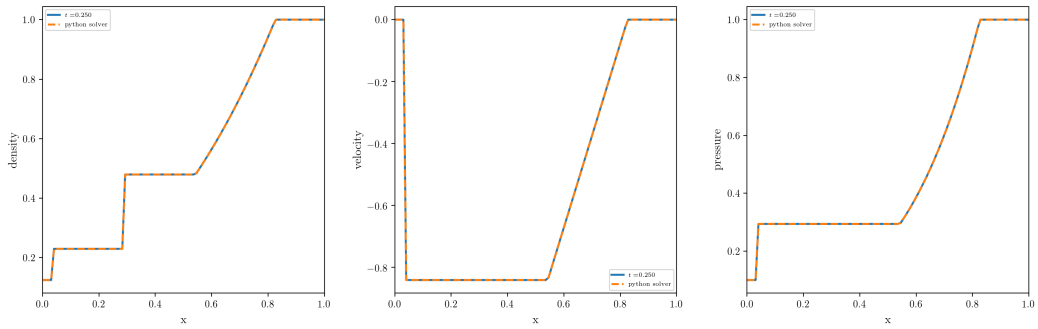

Figure 72: Exact solver for (left facing) sod shock. Obtained result.

2.2 Vacuum

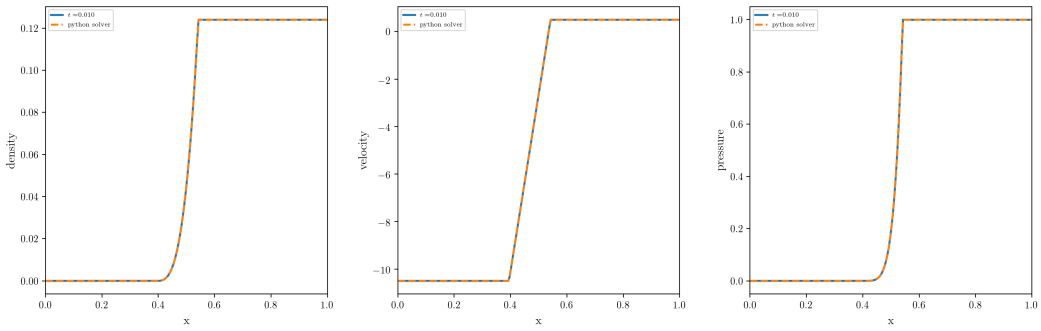

Figure 73: Exact solver for left vacuum state. Expected result.

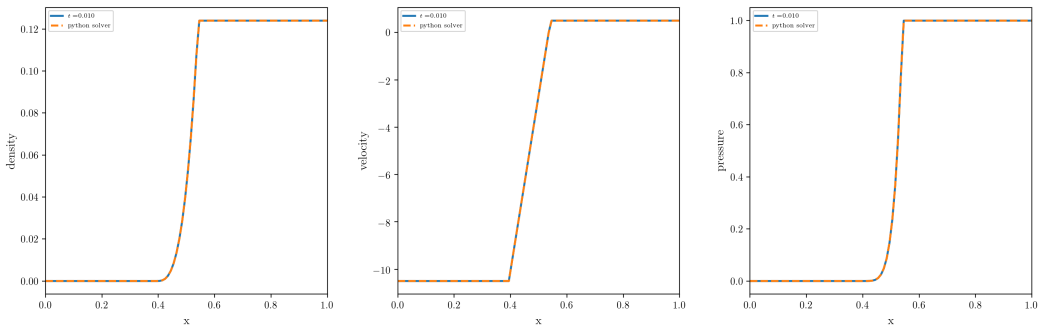

Figure 74: Exact solver for left vacuum state. Obtained result.

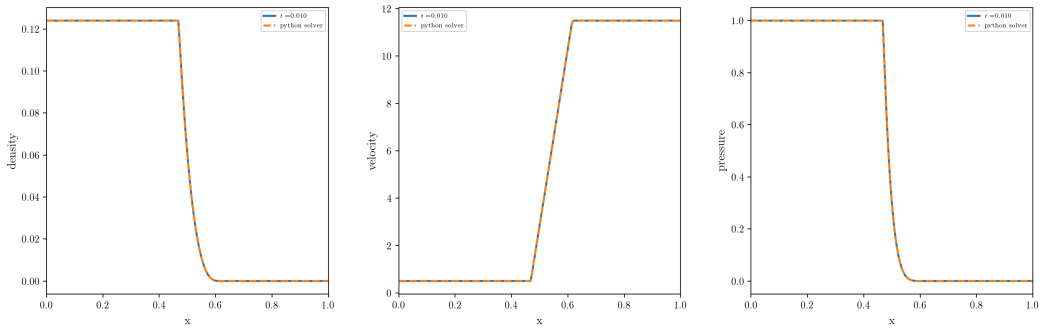

Figure 75: Exact solver for left vacuum state. Expected result.

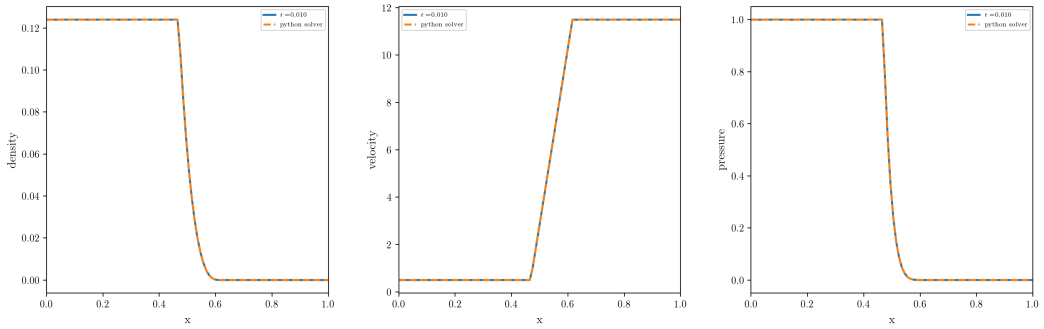

Figure 76: Exact solver for left vacuum state. Obtained result.

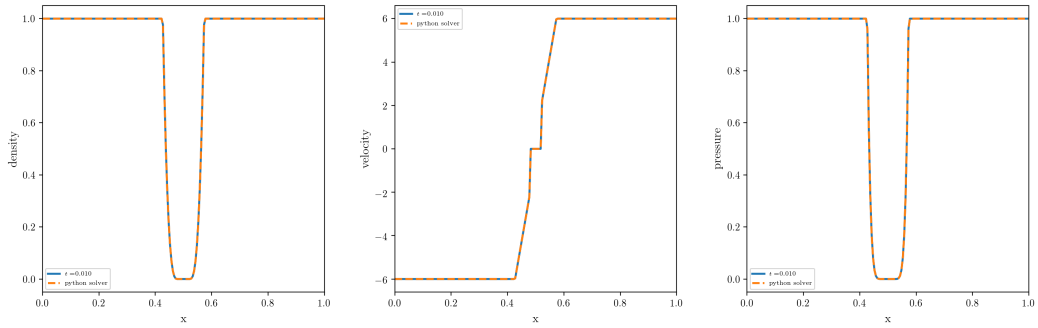

Figure 77: Exact solver for vacuum generating conditions. Expected result.

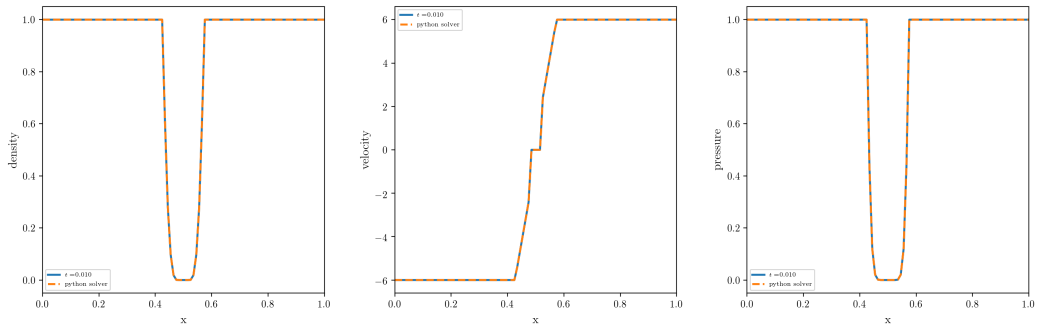

Figure 78: Exact solver for vacuum generating conditions. Obtained result.

3 Godunov's Method

3.1 1D with different Riemann Solvers

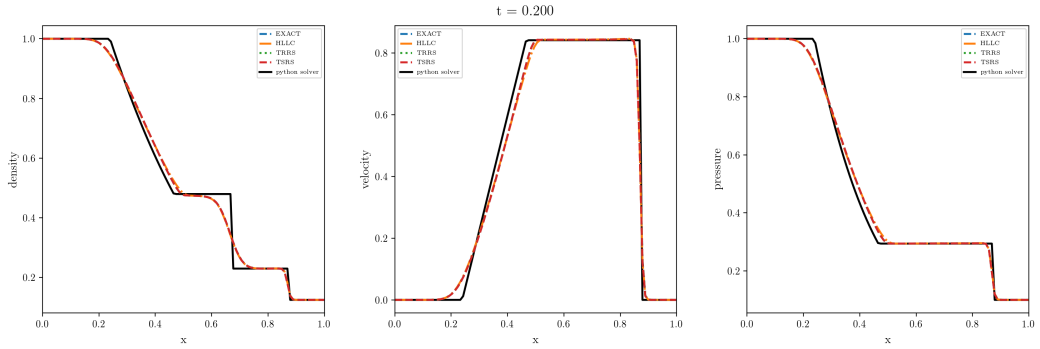

Figure 79: Godunov's method for (right facing) sod shock. Expected result.

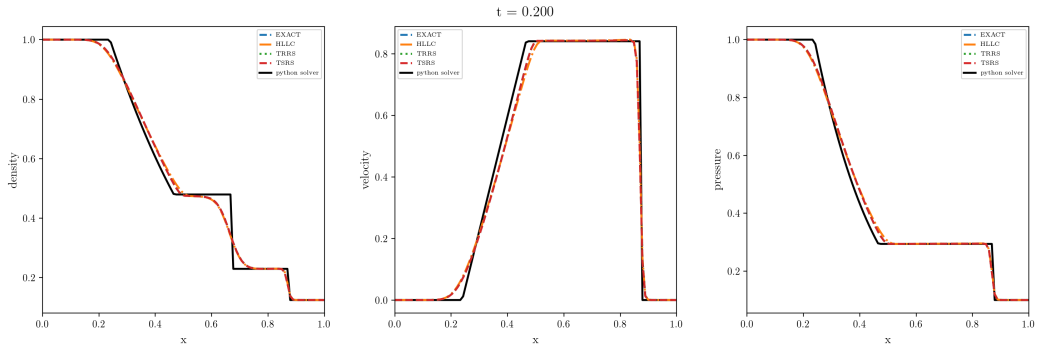

Figure 80: Godunov's method for (right facing) sod shock. Obtained result.

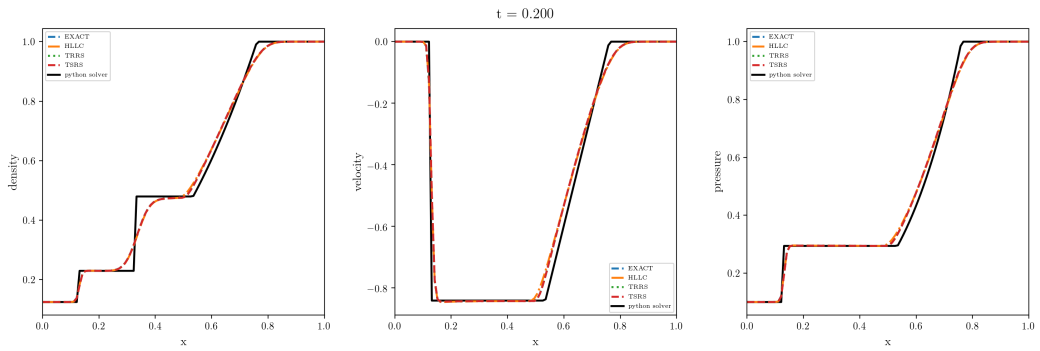

Figure 81: Godunov's method for (left facing) sod shock. Expected result.

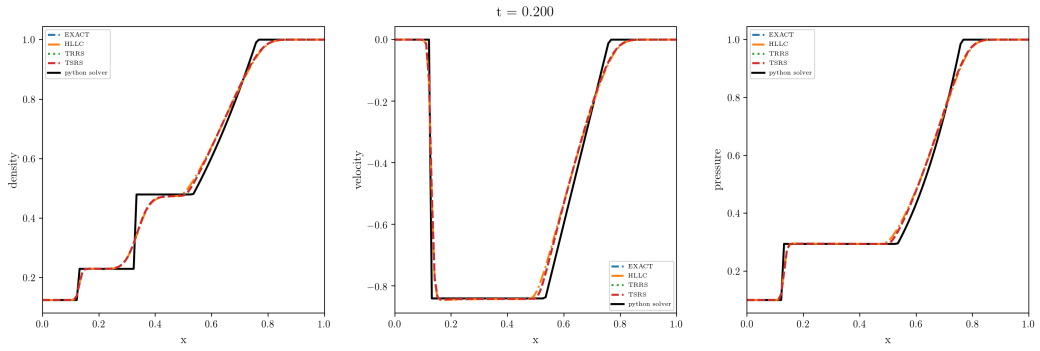

Figure 82: Godunov's method for (left facing) sod shock. Obtained result.

3.2 Vacuum in 1D

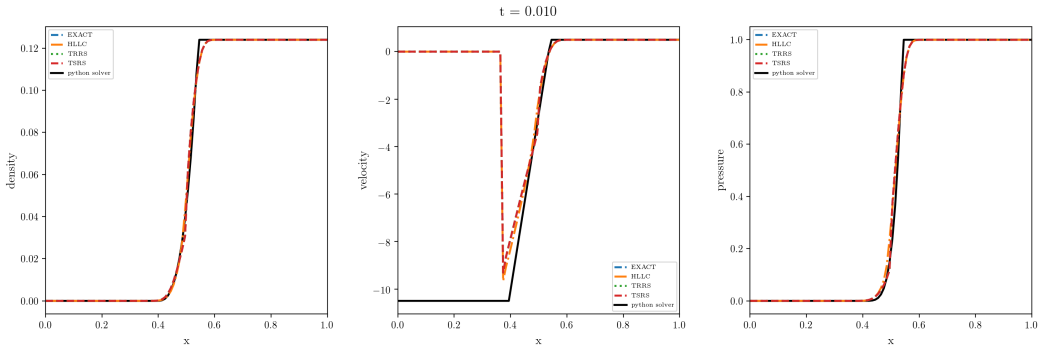

Figure 83: Godunov's method for left vacuum state. Expected result.

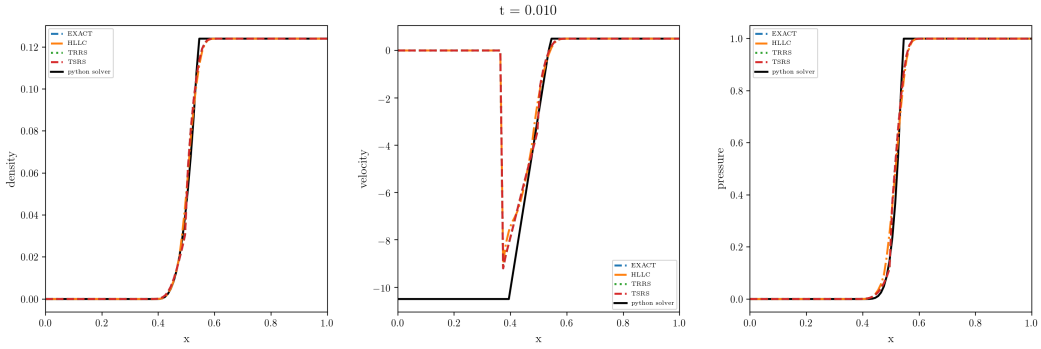

Figure 84: Godunov's method for left vacuum state. Obtained result.

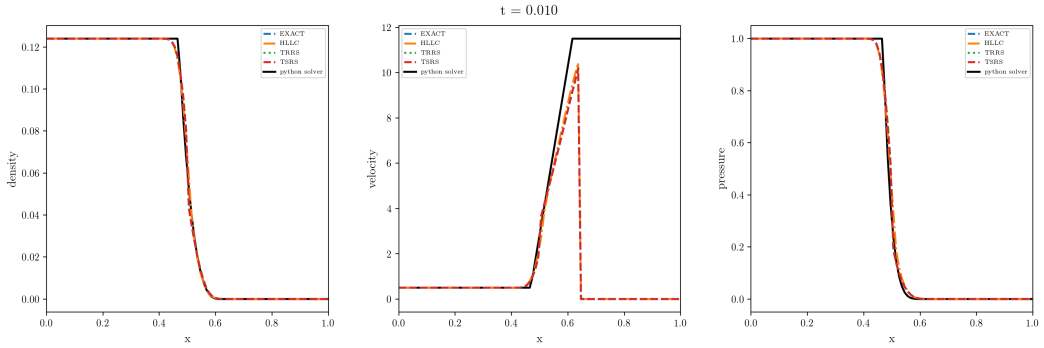

Figure 85: Godunov's method for left vacuum state. Expected result.

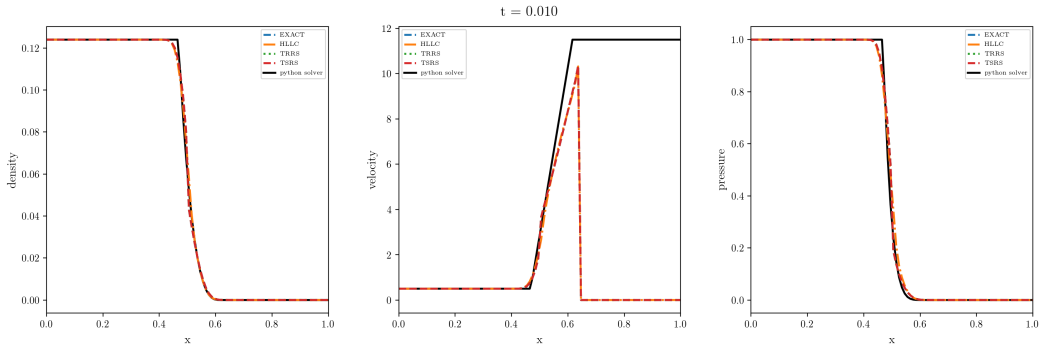

Figure 86: Godunov's method for left vacuum state. Obtained result.

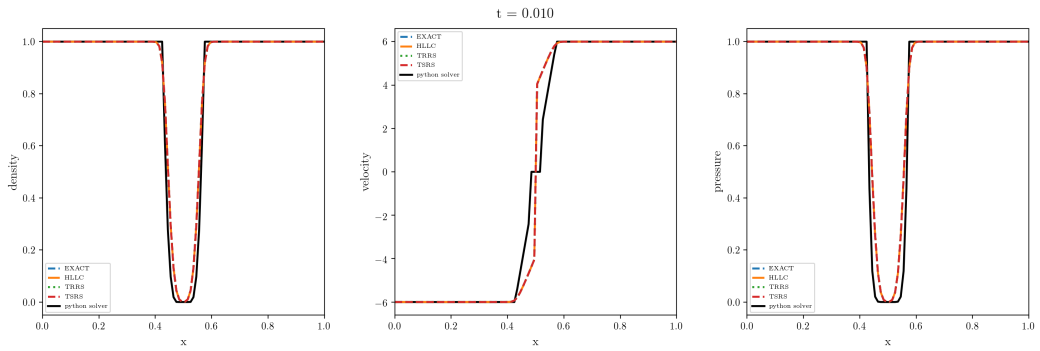

Figure 87: Godunov's method for vacuum generating conditions. Expected result.

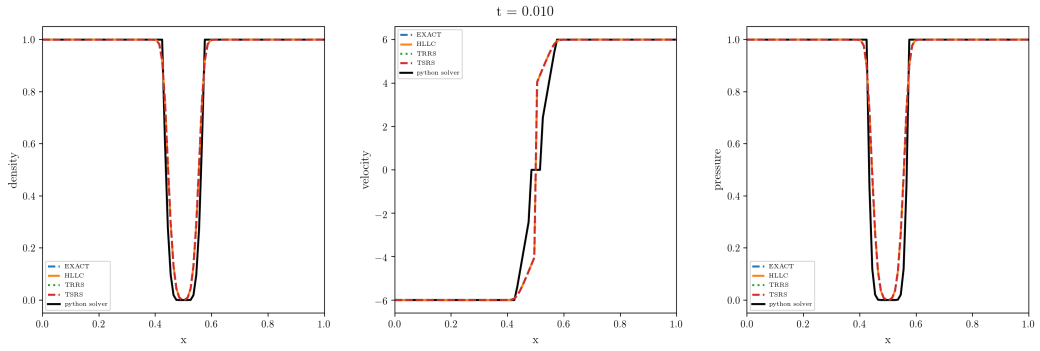

Figure 88: Godunov's method for vacuum generating conditions. Obtained result.

3.3 2D with different Riemann Solvers

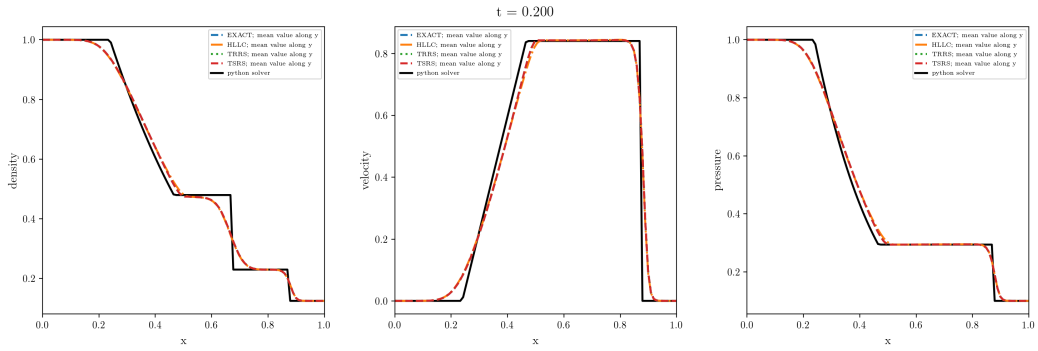

Figure 89: Godunov's method for (right facing) sod shock. Expected result.

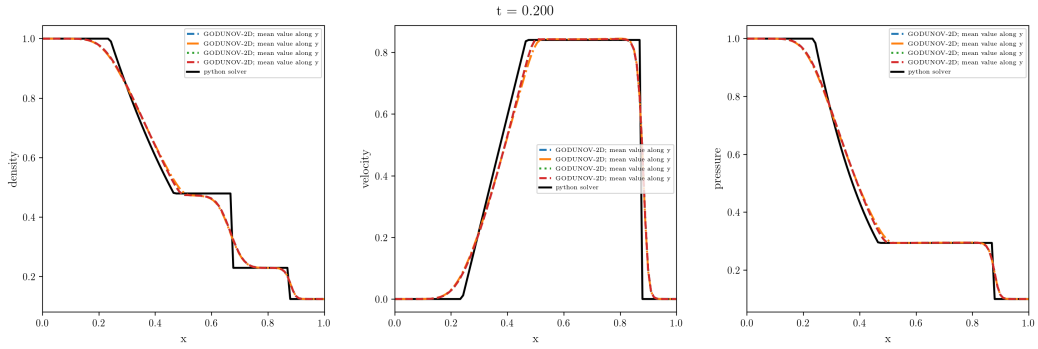

Figure 90: Godunov's method for (right facing) sod shock. Obtained result.

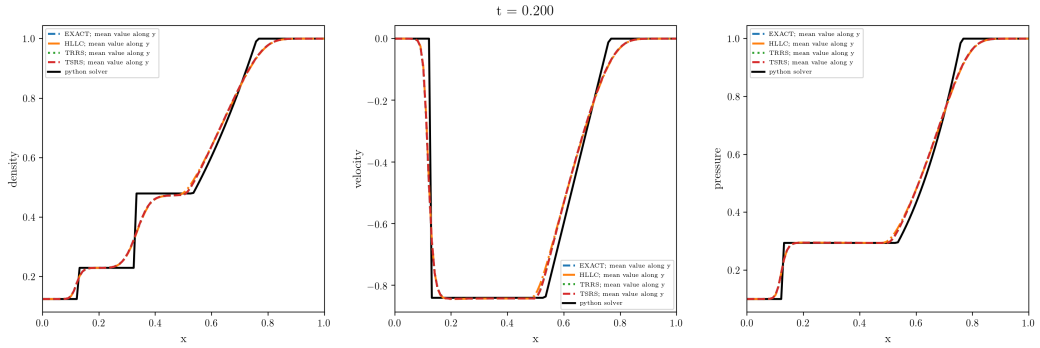

Figure 91: Godunov's method for (left facing) sod shock. Expected result.

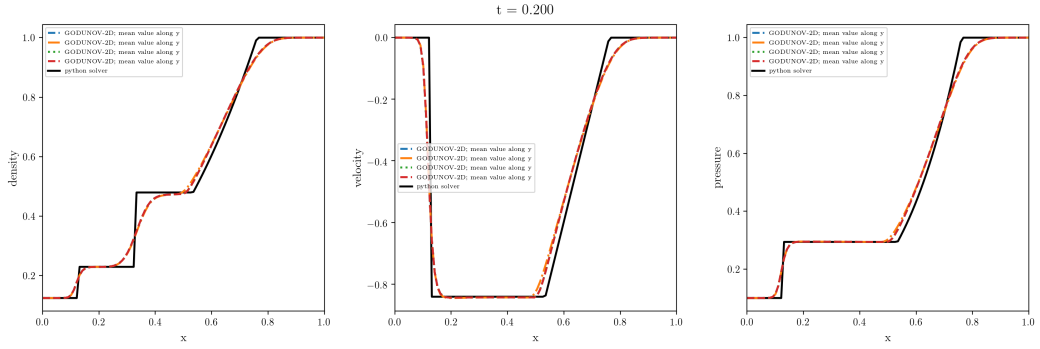

Figure 92: Godunov's method for (left facing) sod shock. Obtained result.

3.4 Vacuum in 2D

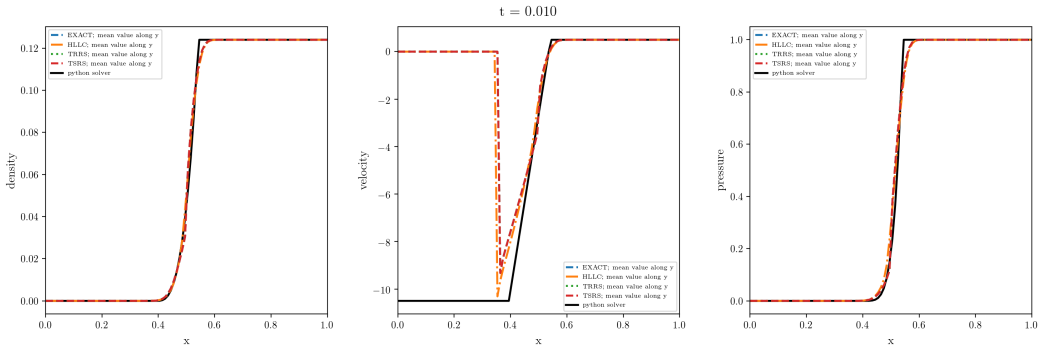

Figure 93: Godunov's method for left vacuum state. Expected result.

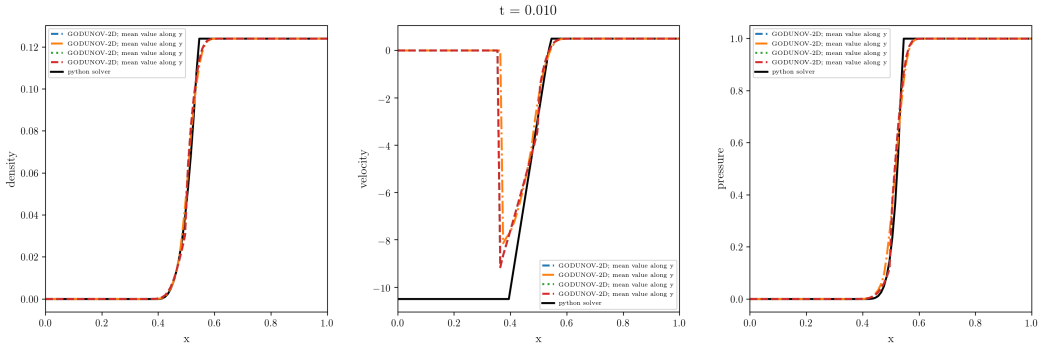

Figure 94: Godunov's method for left vacuum state. Obtained result.

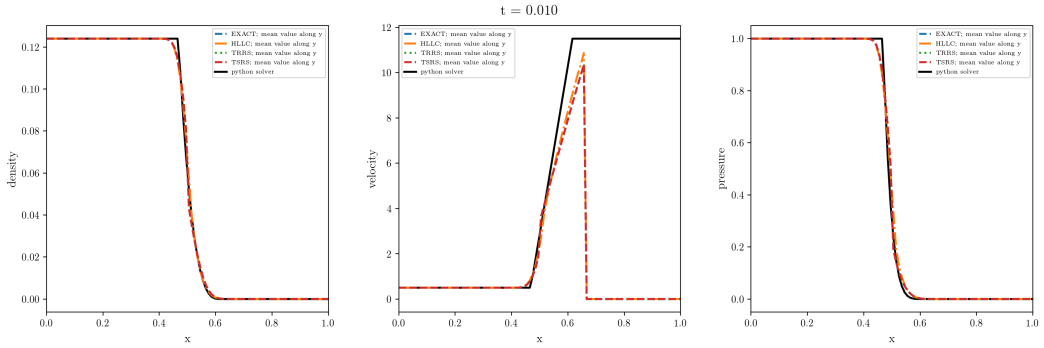

Figure 95: Godunov's method for left vacuum state. Expected result.

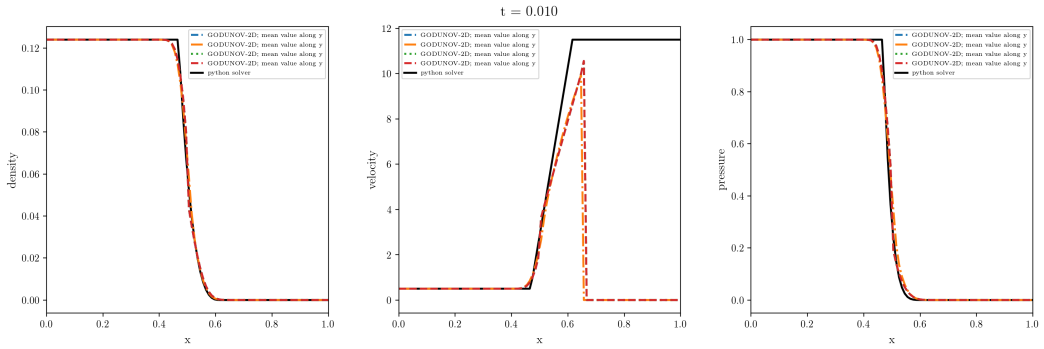

Figure 96: Godunov's method for left vacuum state. Obtained result.

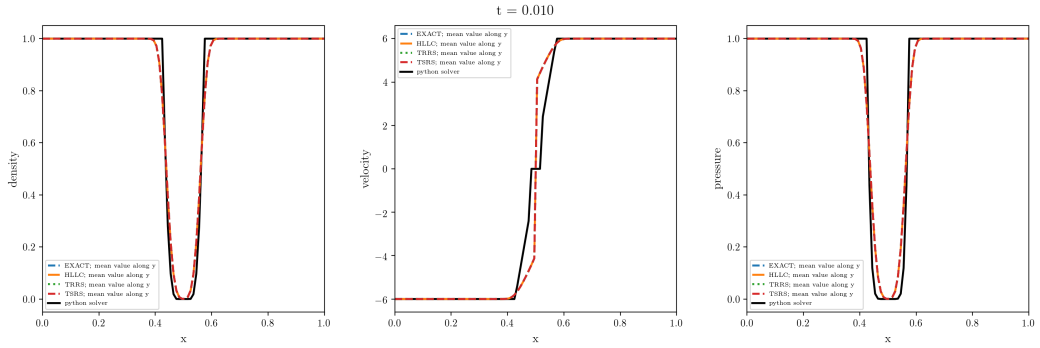

Figure 97: Godunov's method for vacuum generating conditions. Expected result.

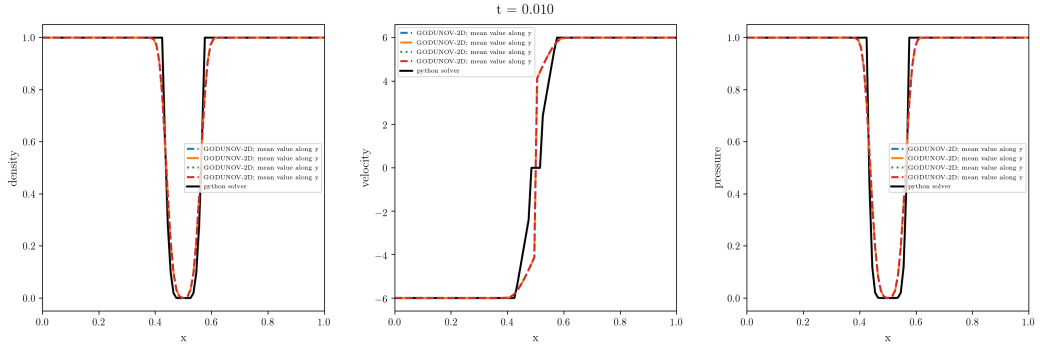

Figure 98: Godunov's method for vacuum generating conditions. Obtained result.

3.5 Others in 2D

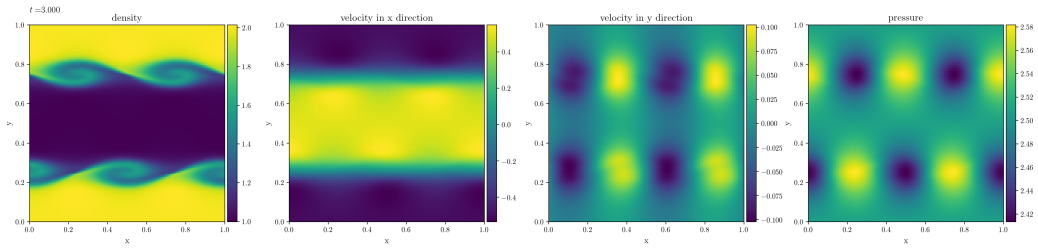

Figure 99: Godunov's method for Kelvin Helmholtz instability. Expected result.

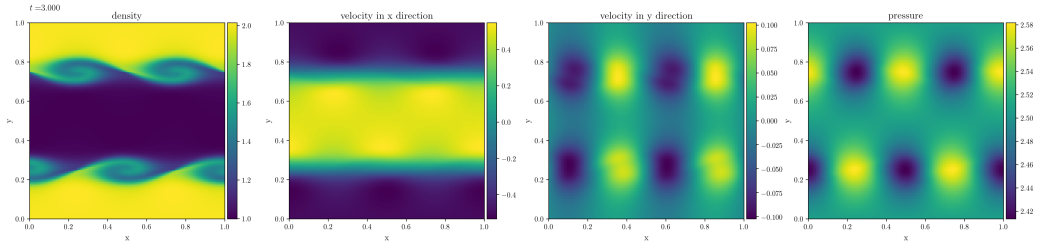

Figure 100: Godunov's method for Kelvin Helmholtz instability. Obtained result.

4 WAF Method

4.1 1D with different Limiters

4.1.1 Without limiter

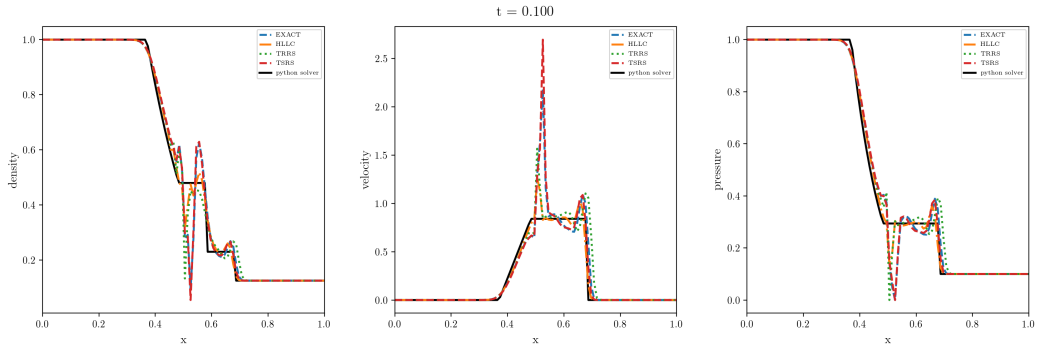

Figure 101: WAF method for (right facing) sod shock, no flux limiter. Expected result.

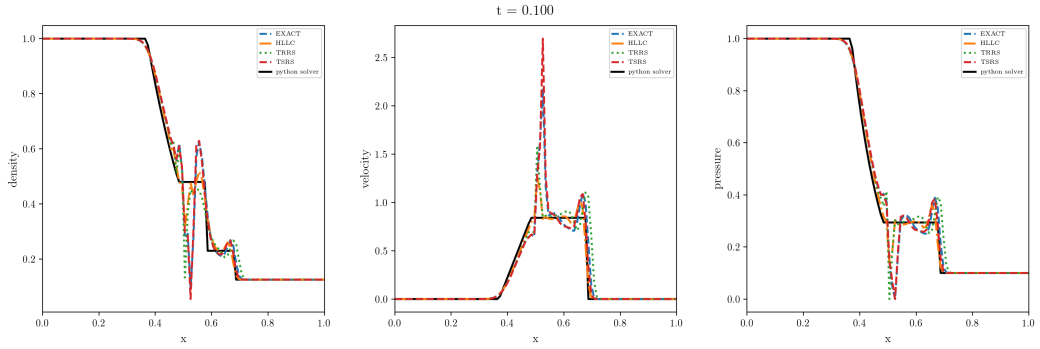

Figure 102: WAF method for (right facing) sod shock, no flux limiter. Obtained result.

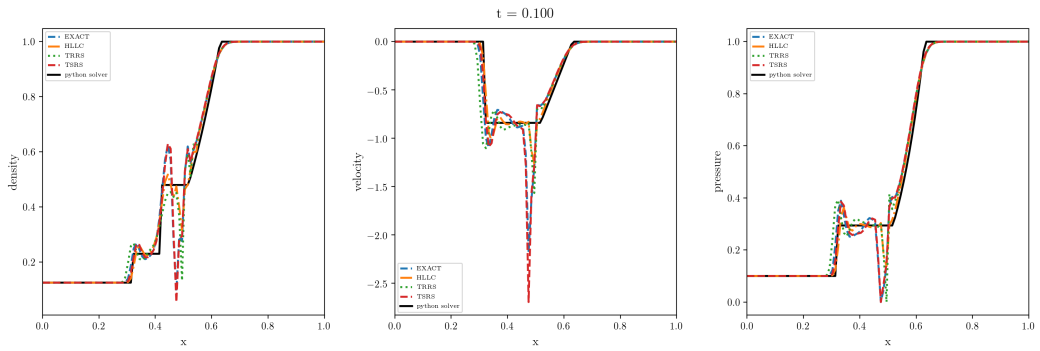

Figure 103: WAF method for (left facing) sod shock, no flux limiter. Expected result.

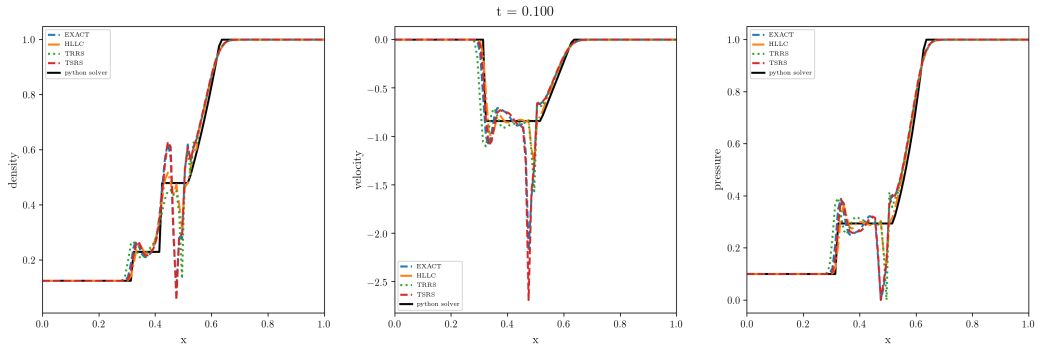

Figure 104: WAF method for (left facing) sod shock, no flux limiter. Obtained result.

4.1.2 MC limiter

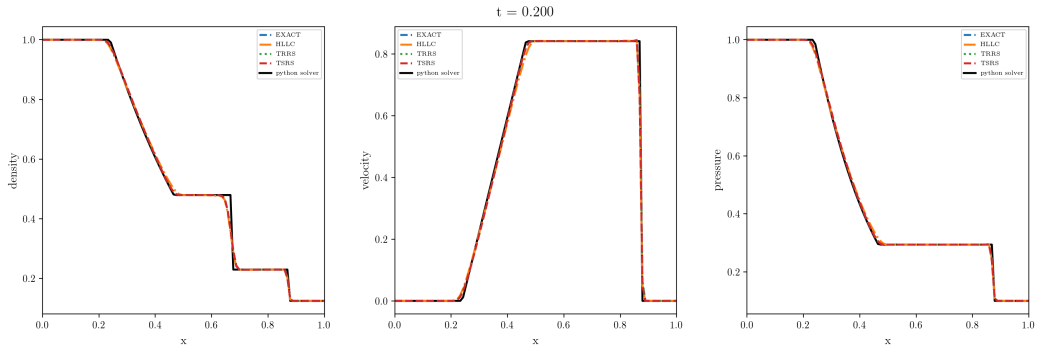

Figure 105: WAF method for (right facing) sod shock, MC flux limiter. Expected result.

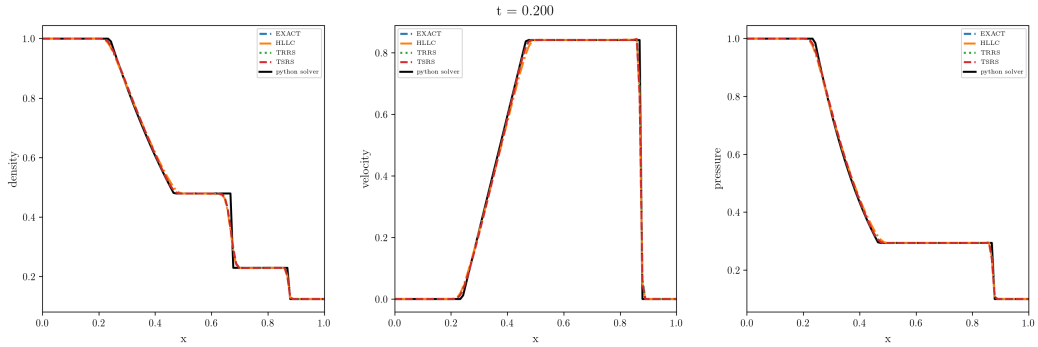

Figure 106: WAF method for (right facing) sod shock, MC flux limiter. Obtained result.

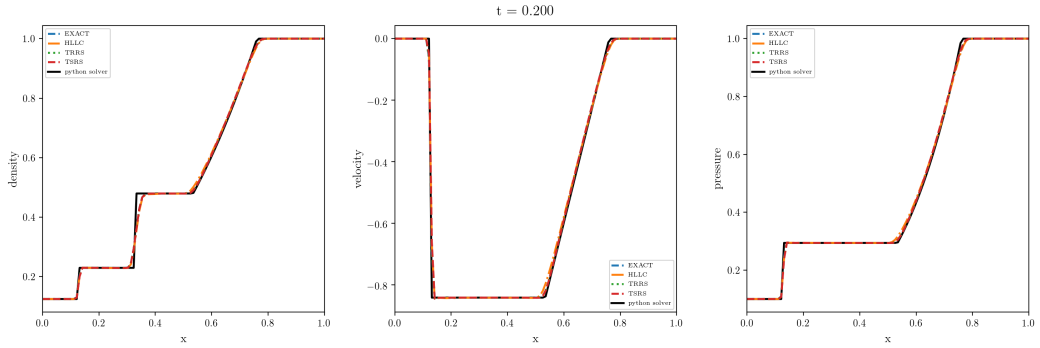

Figure 107: WAF method for (left facing) sod shock, MC flux limiter. Expected result.

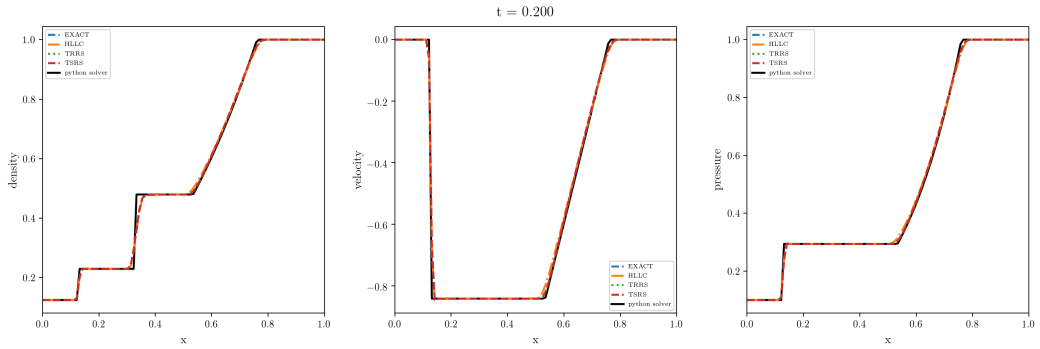

Figure 108: WAF method for (left facing) sod shock, MC flux limiter. Obtained result.

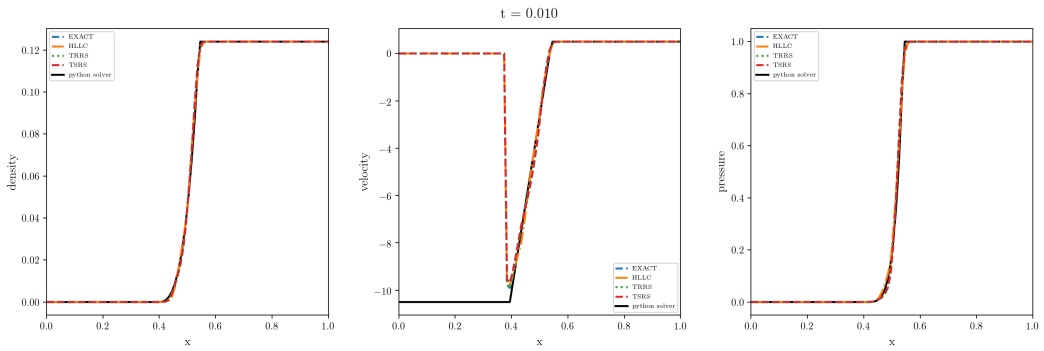

Figure 109: WAF method for left vacuum state, MC flux limiter. Expected result.

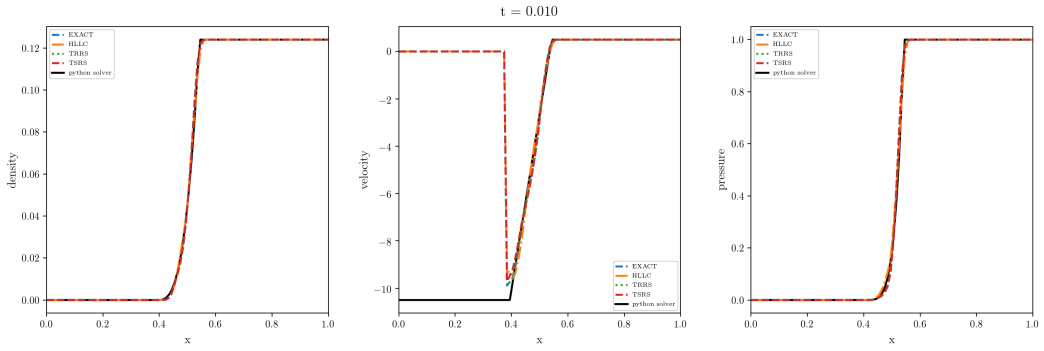

Figure 110: WAF method for left vacuum state, MC flux limiter. Obtained result.

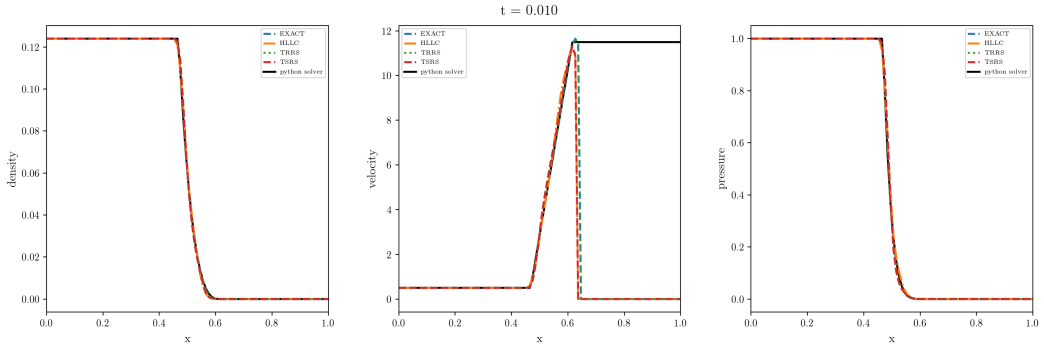

Figure 111: WAF method for left vacuum state, MC flux limiter. Expected result.

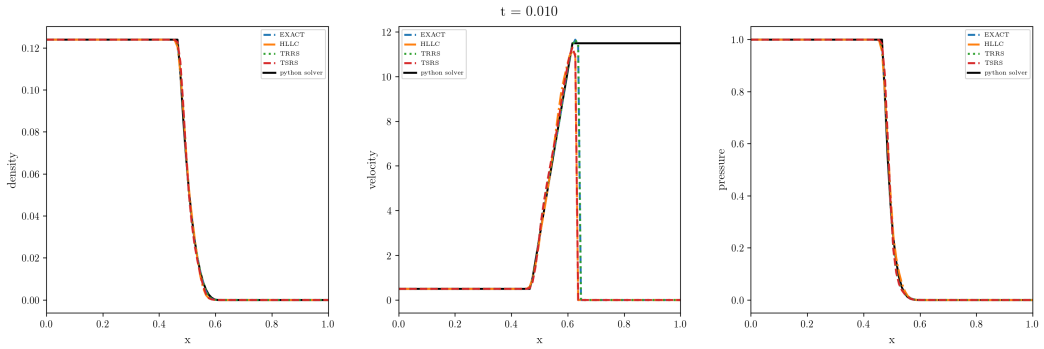

Figure 112: WAF method for left vacuum state, MC flux limiter. Obtained result.

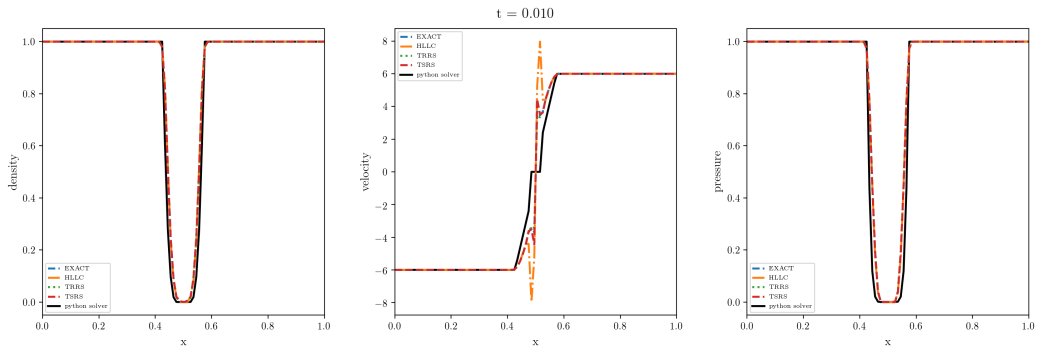

Figure 113: WAF method for vacuum generating conditions, MC flux limiter. Expected result.

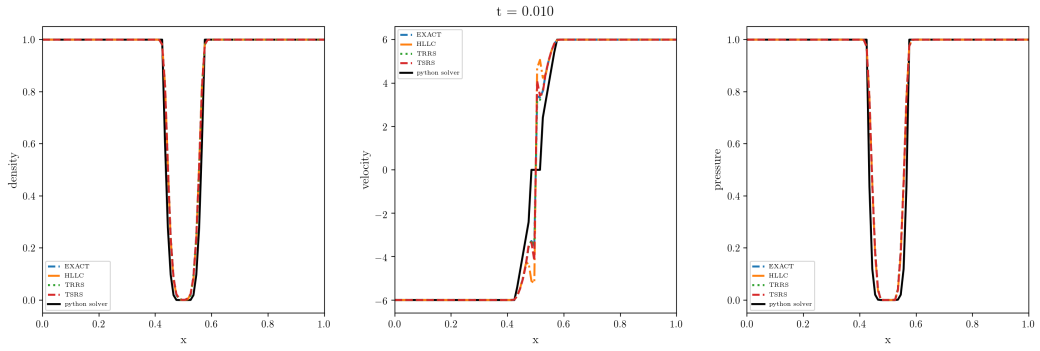

Figure 114: WAF method for vacuum generating conditions, MC flux limiter. Obtained result.

4.1.3 MINMOD limiter

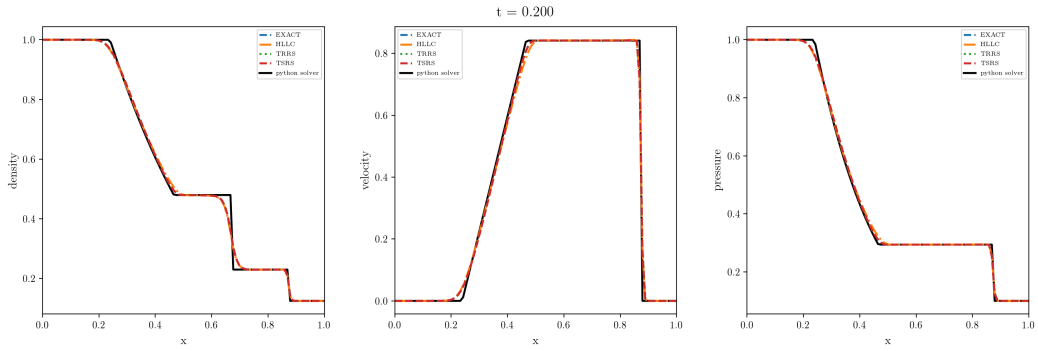

Figure 115: WAF method for (right facing) sod shock, MINMOD flux limiter. Expected result.

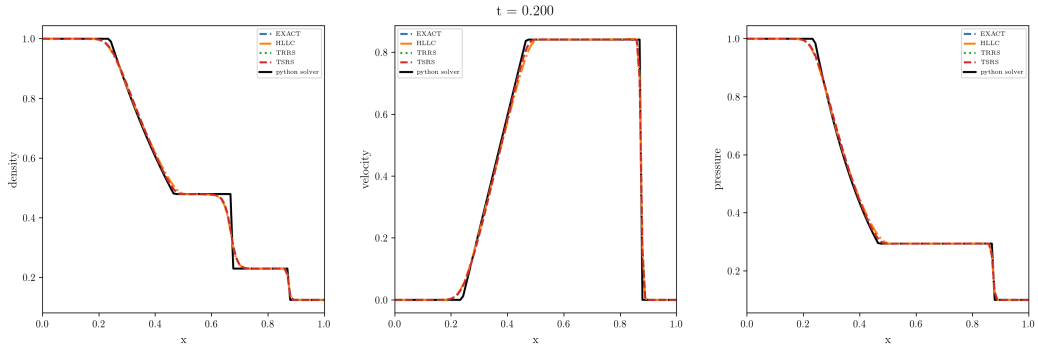

Figure 116: WAF method for (right facing) sod shock, MINMOD flux limiter. Obtained result.

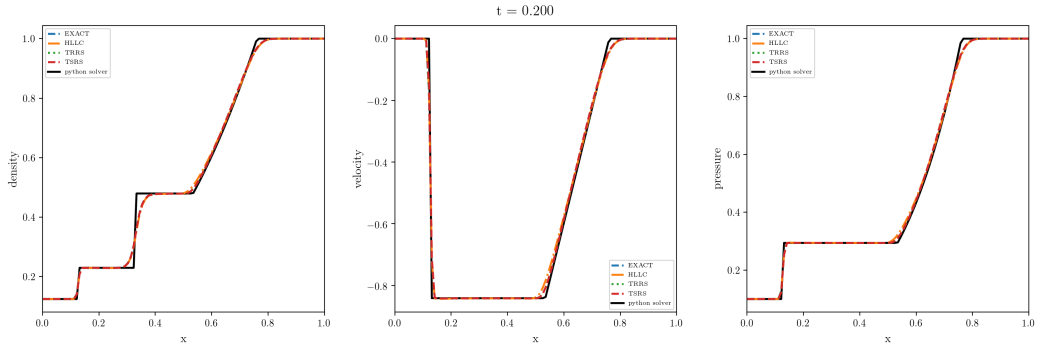

Figure 117: WAF method for (left facing) sod shock, MINMOD flux limiter. Expected result.

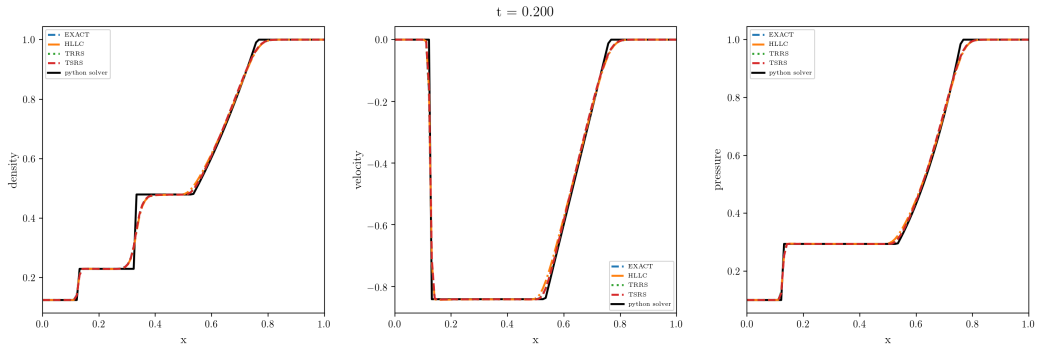

Figure 118: WAF method for (left facing) sod shock, MINMOD flux limiter. Obtained result.

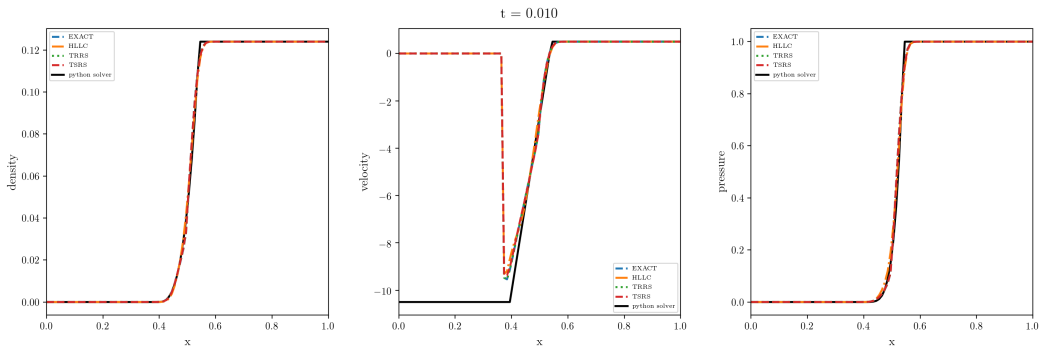

Figure 119: WAF method for left vacuum state, MINMOD flux limiter. Expected result.

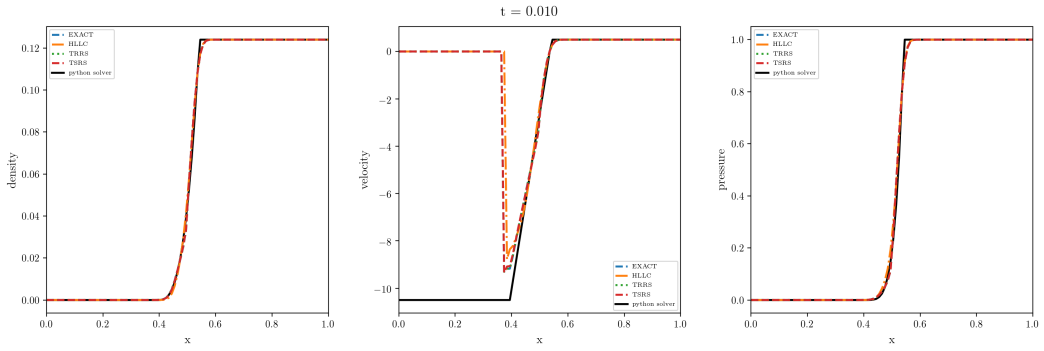

Figure 120: WAF method for left vacuum state, MINMOD flux limiter. Obtained result.

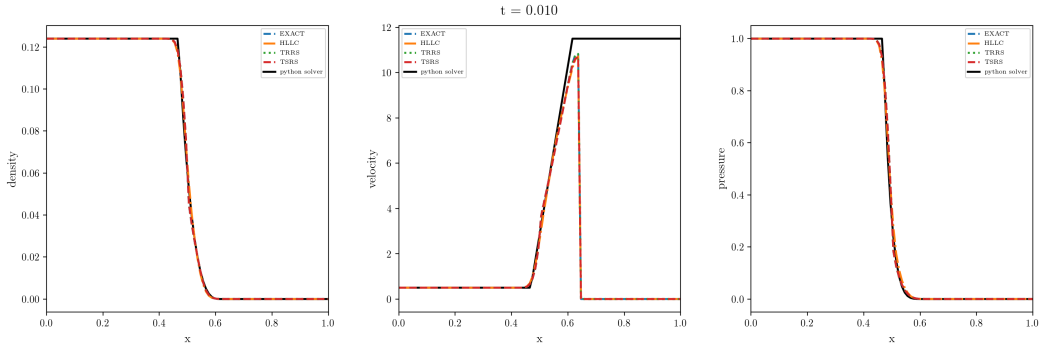

Figure 121: WAF method for left vacuum state, MINMOD flux limiter. Expected result.

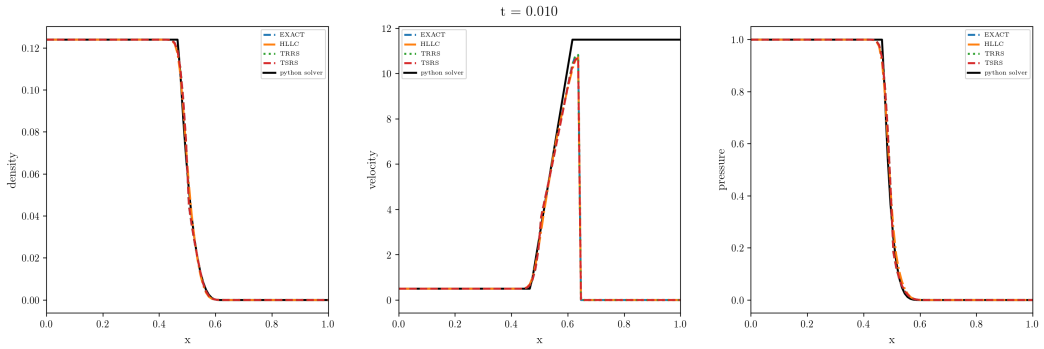

Figure 122: WAF method for left vacuum state, MINMOD flux limiter. Obtained result.

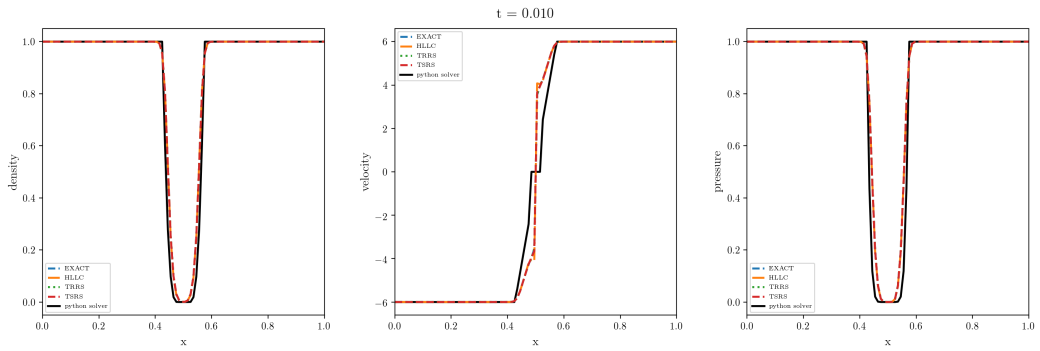

Figure 123: WAF method for vacuum generating conditions, MINMOD flux limiter. Expected result.

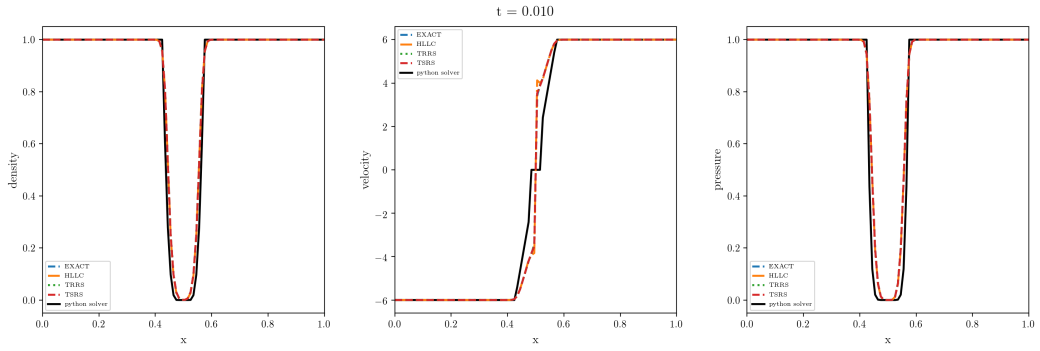

Figure 124: WAF method for vacuum generating conditions, MINMOD flux limiter. Obtained result.

4.1.4 van Leer limiter

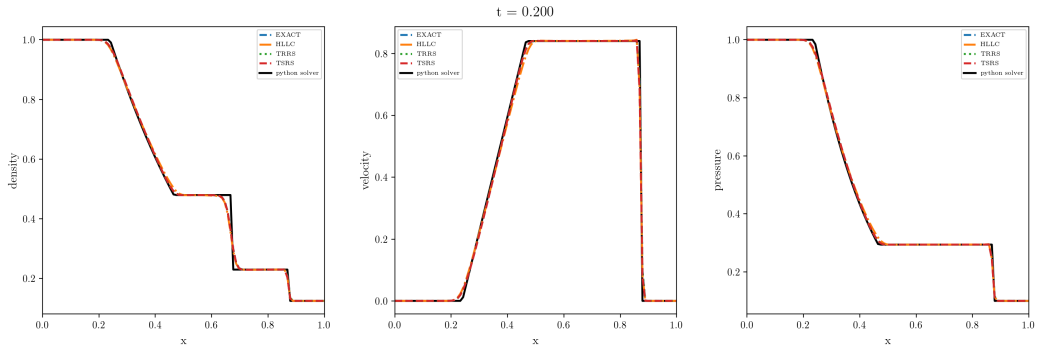

Figure 125: WAF method for (right facing) sod shock, van Leer flux limiter. Expected result.

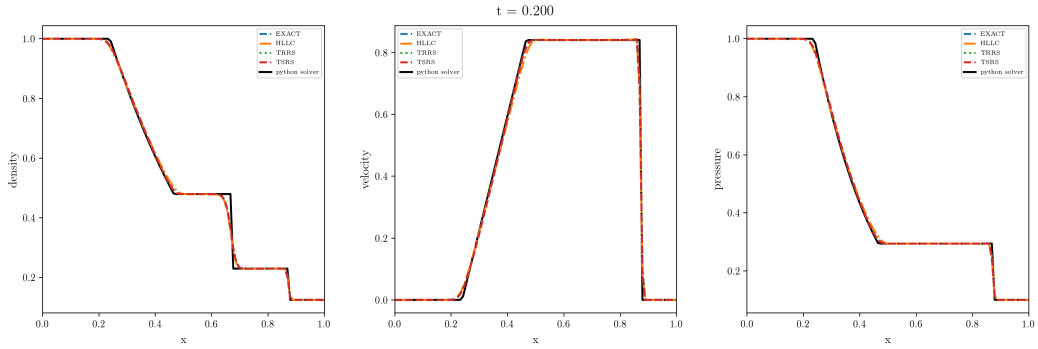

Figure 126: WAF method for (right facing) sod shock, van Leer flux limiter. Obtained result.

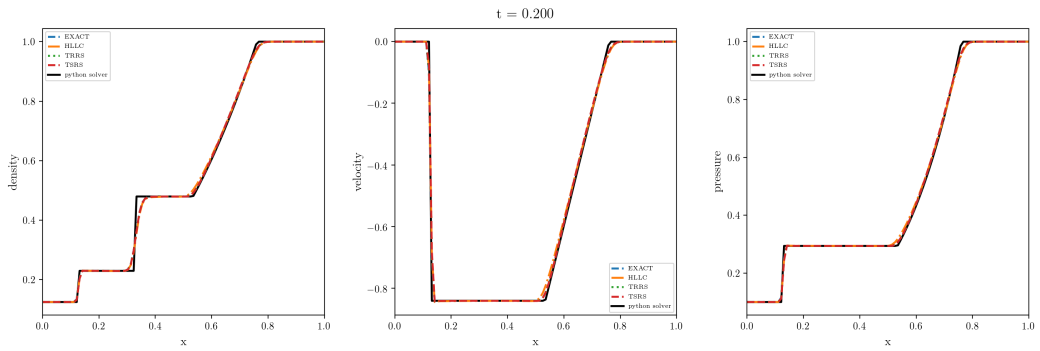

Figure 127: WAF method for (left facing) sod shock, van Leer flux limiter. Expected result.

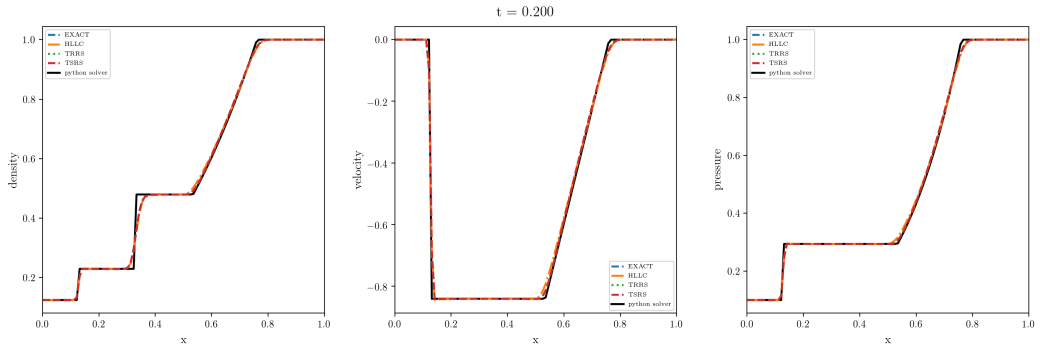

Figure 128: WAF method for (left facing) sod shock, van Leer flux limiter. Obtained result.

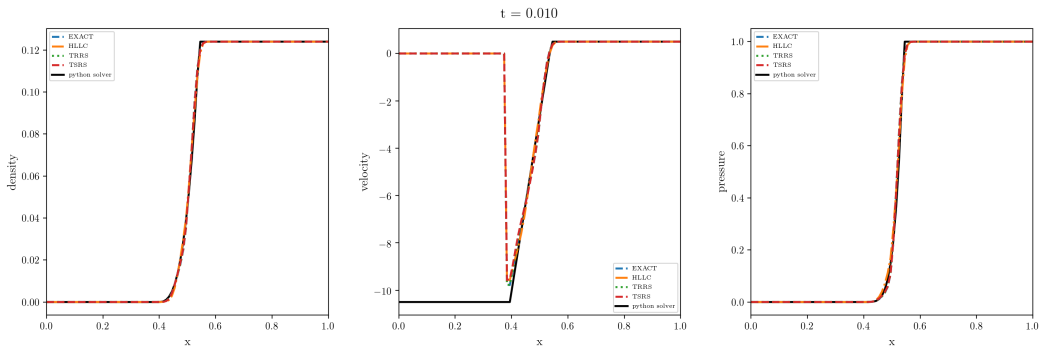

Figure 129: WAF method for left vacuum state, van Leer flux limiter. Expected result.

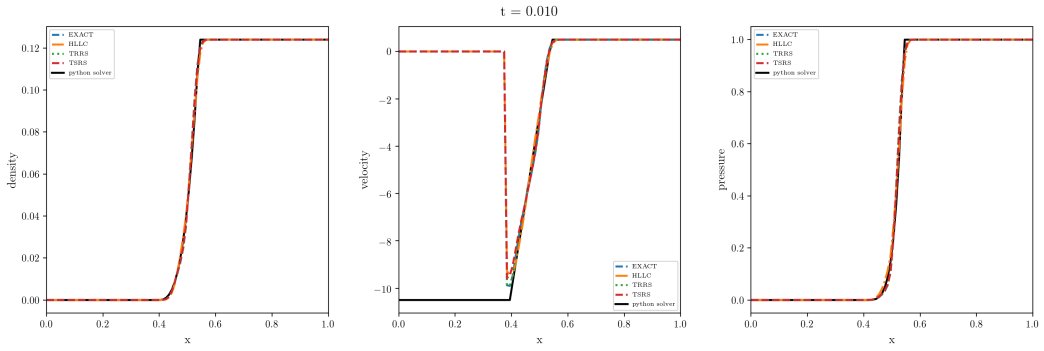

Figure 130: WAF method for left vacuum state, van Leer flux limiter. Obtained result.

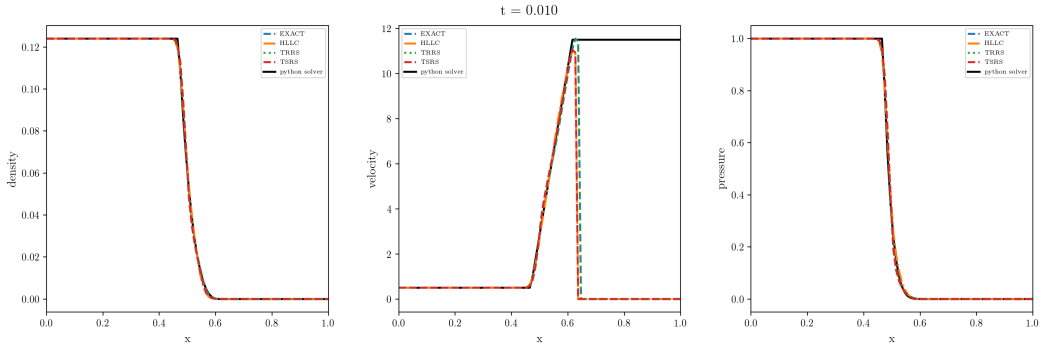

Figure 131: WAF method for left vacuum state, van Leer flux limiter. Expected result.

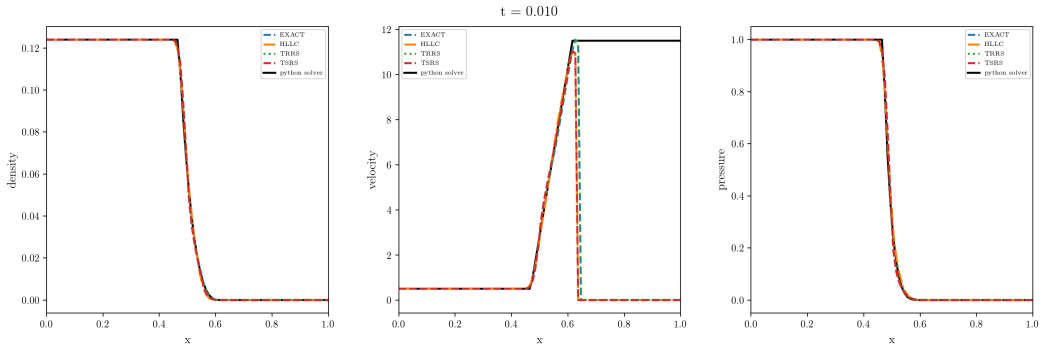

Figure 132: WAF method for left vacuum state, van Leer flux limiter. Obtained result.

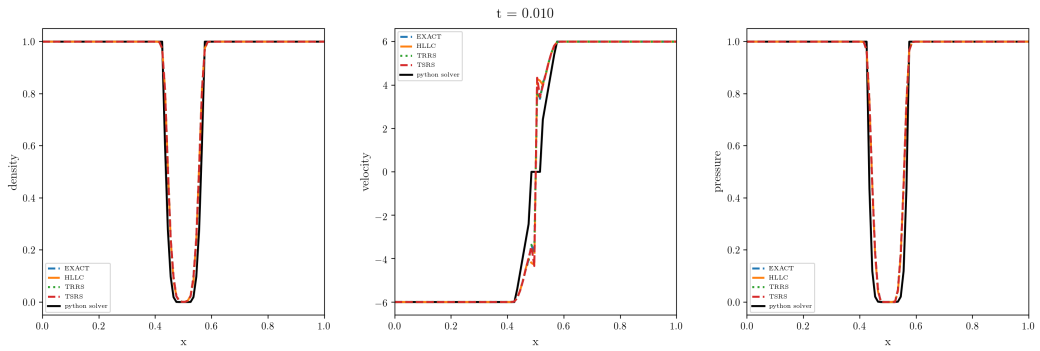

Figure 133: WAF method for vacuum generating conditions, van Leer flux limiter. Expected result.

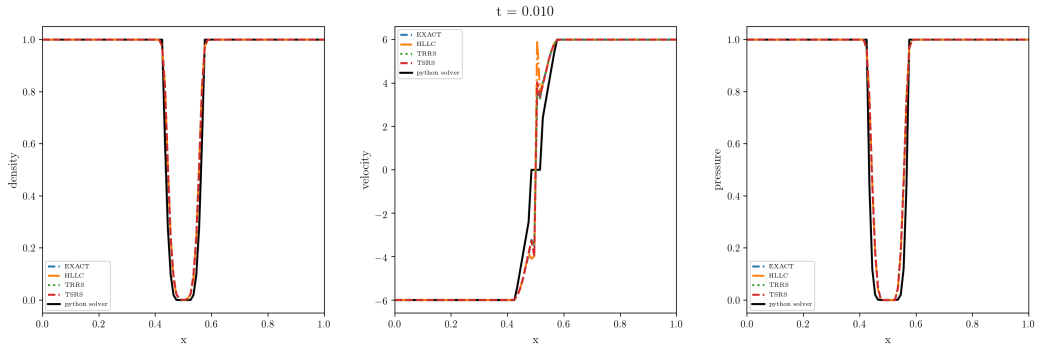

Figure 134: WAF method for vacuum generating conditions, van Leer flux limiter. Obtained result.

4.1.5 SUPERBEE limiter

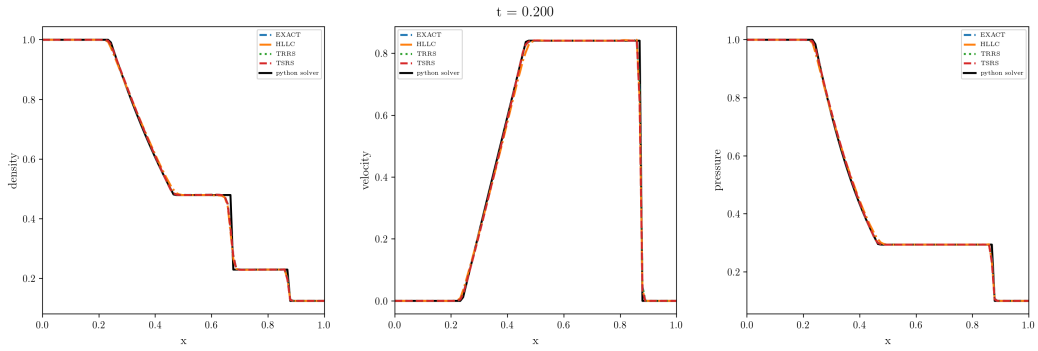

Figure 135: WAF method for (right facing) sod shock, SUPERBEE flux limiter. Expected result.

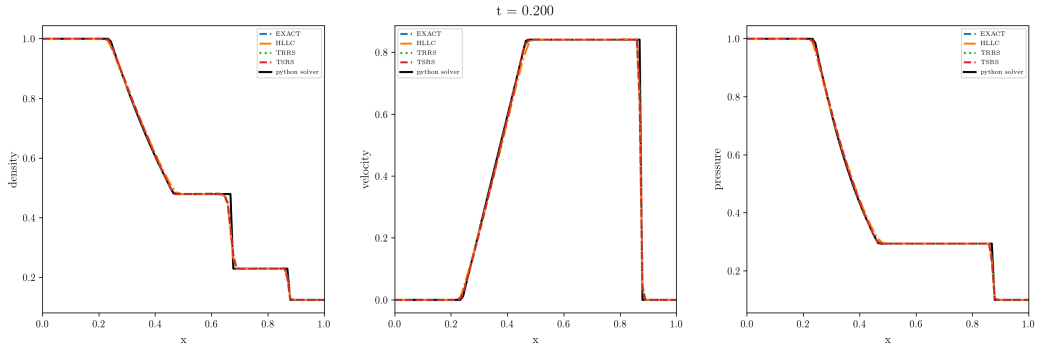

Figure 136: WAF method for (right facing) sod shock, SUPERBEE flux limiter. Obtained result.

4.2 2D with different Limiters

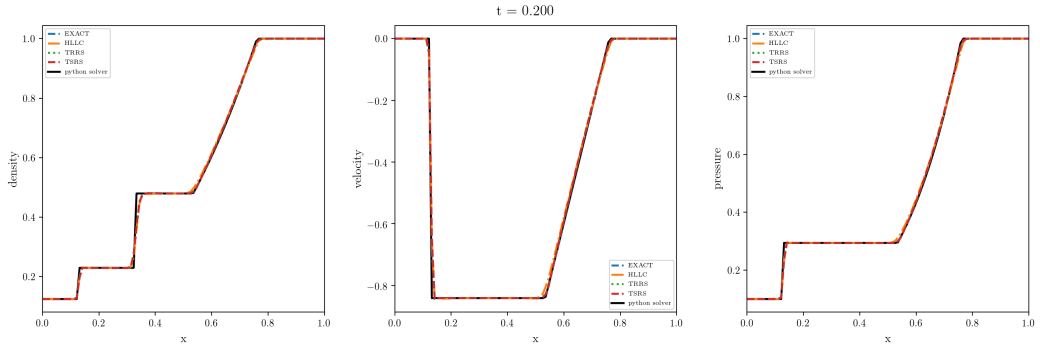

Figure 137: WAF method for (left facing) sod shock, SUPERBEE flux limiter. Expected result.

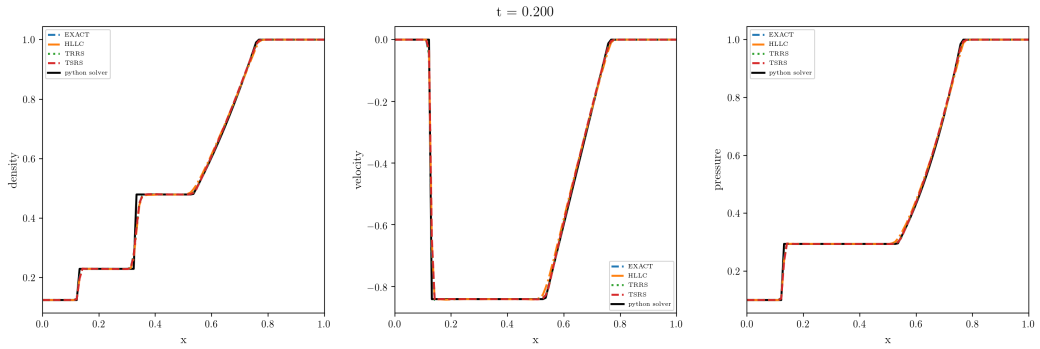

Figure 138: WAF method for (left facing) sod shock, SUPERBEE flux limiter. Obtained result.

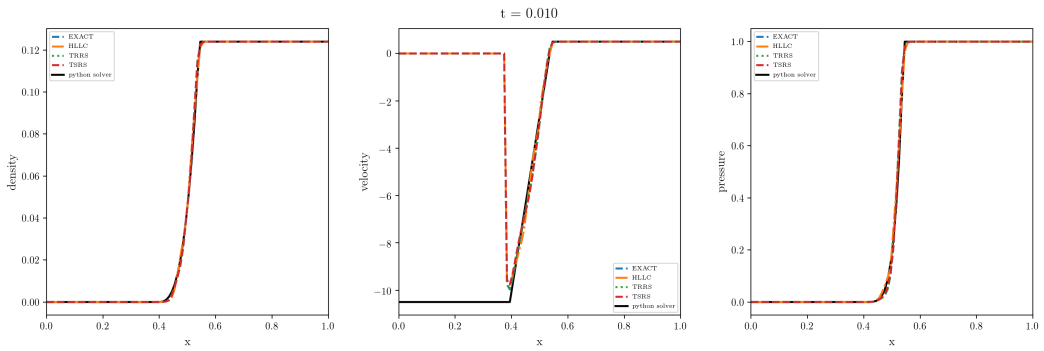

Figure 139: WAF method for left vacuum state, SUPERBEE flux limiter. Expected result.

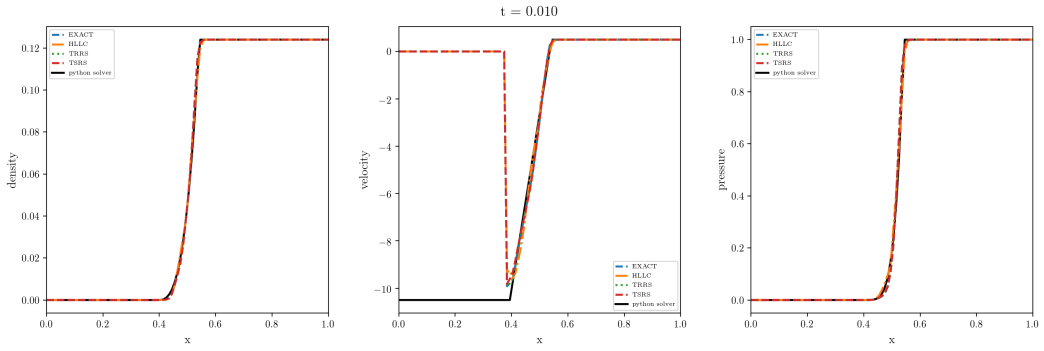

Figure 140: WAF method for left vacuum state, SUPERBEE flux limiter. Obtained result.

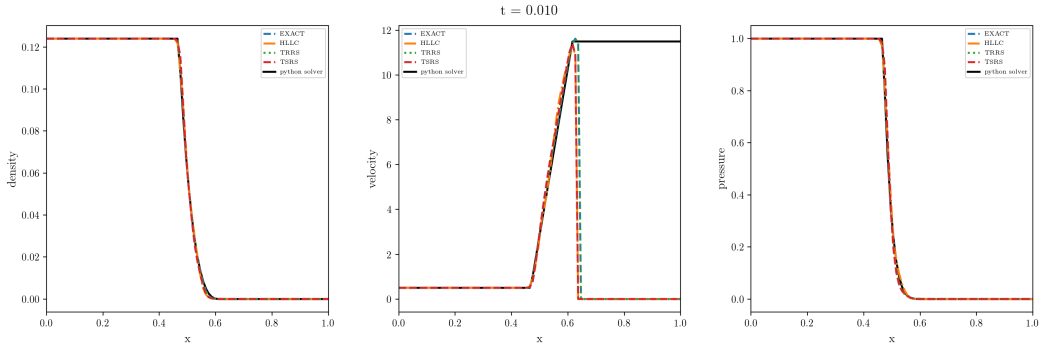

Figure 141: WAF method for left vacuum state, SUPERBEE flux limiter. Expected result.

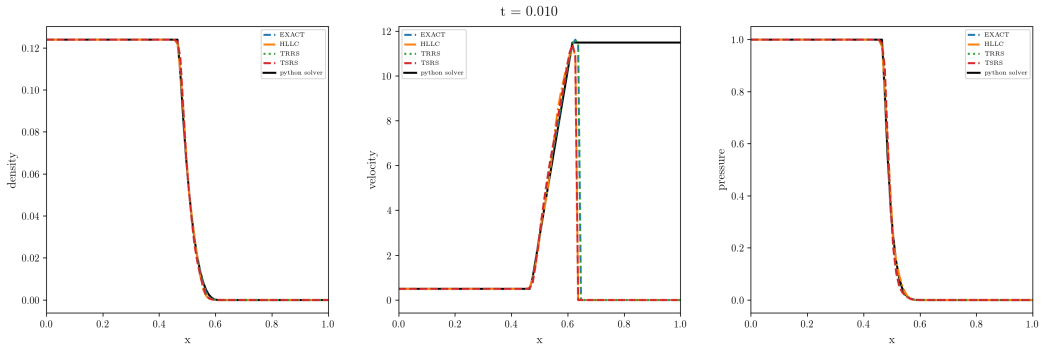

Figure 142: WAF method for left vacuum state, SUPERBEE flux limiter. Obtained result.

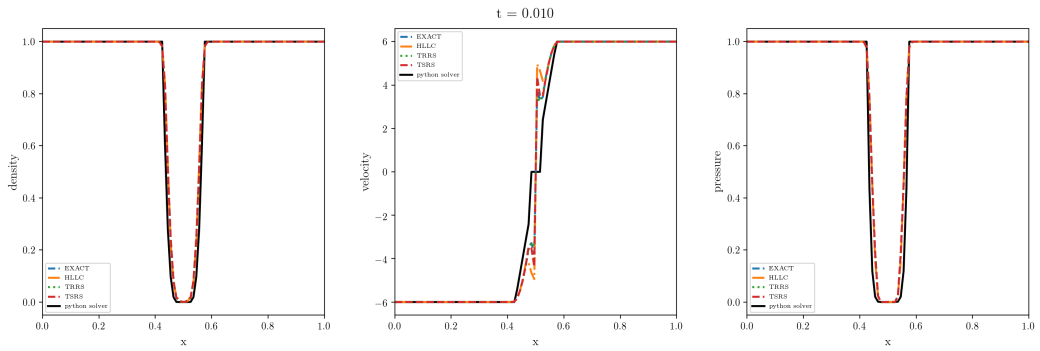

Figure 143: WAF method for vacuum generating conditions, SUPERBEE flux limiter. Expected result.

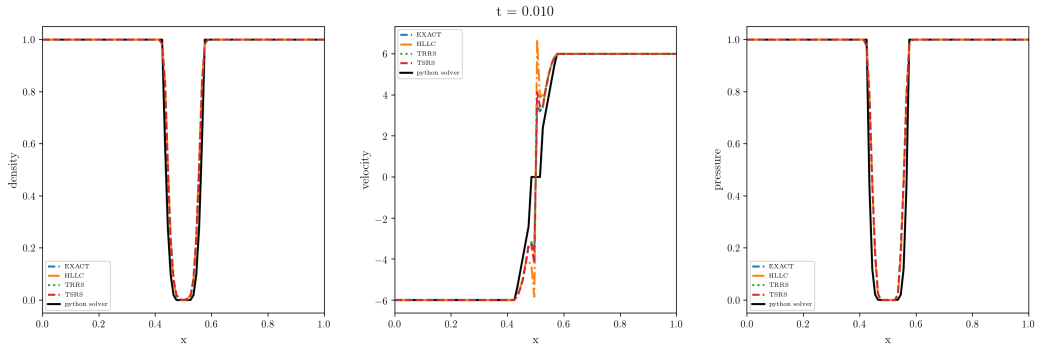

Figure 144: WAF method for vacuum generating conditions, SUPERBEE flux limiter. Obtained result.

4.2.1 MC limiter

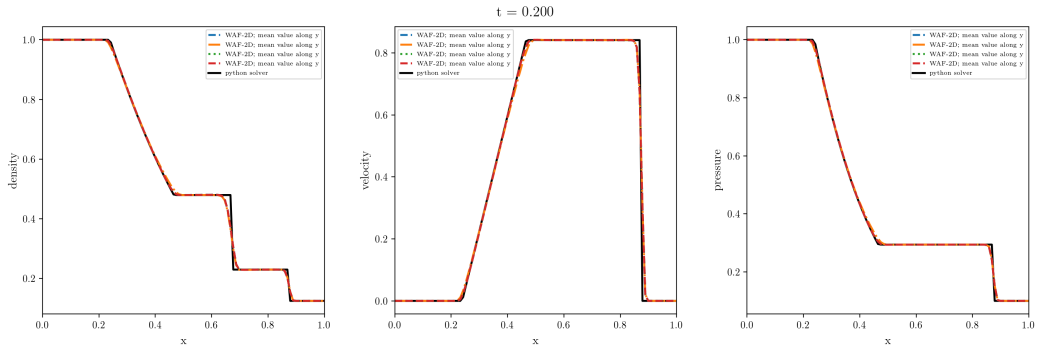

Figure 145: WAF method for (right facing) sod shock, MC flux limiter. Expected result.

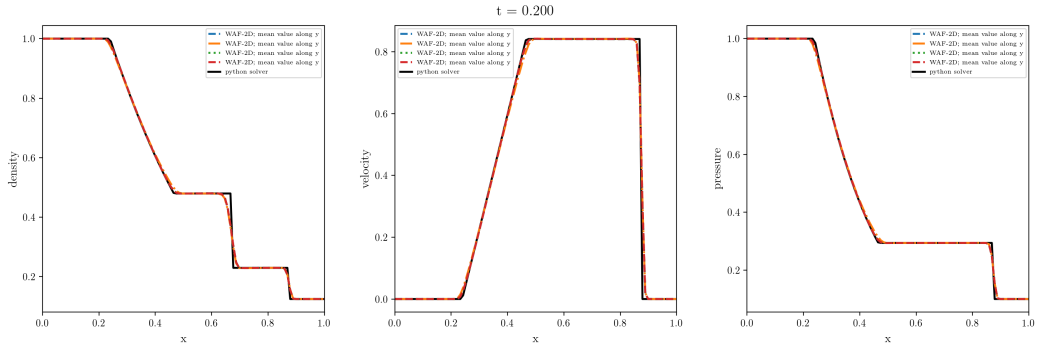

Figure 146: WAF method for (right facing) sod shock, MC flux limiter. Obtained result.

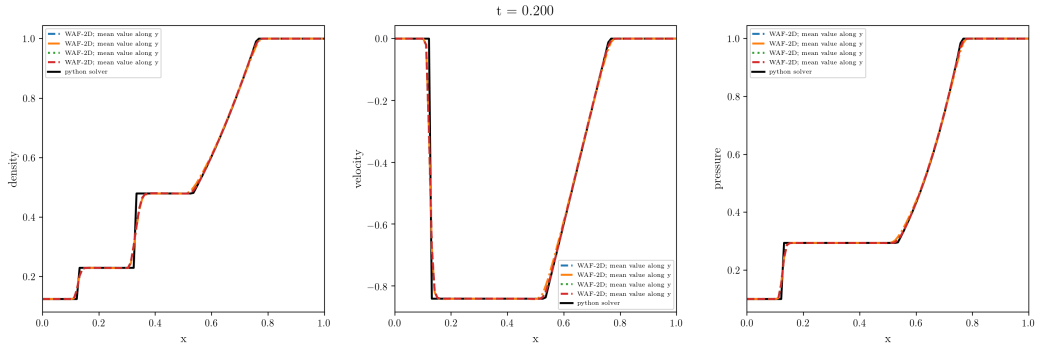

Figure 147: WAF method for (left facing) sod shock, MC flux limiter. Expected result.

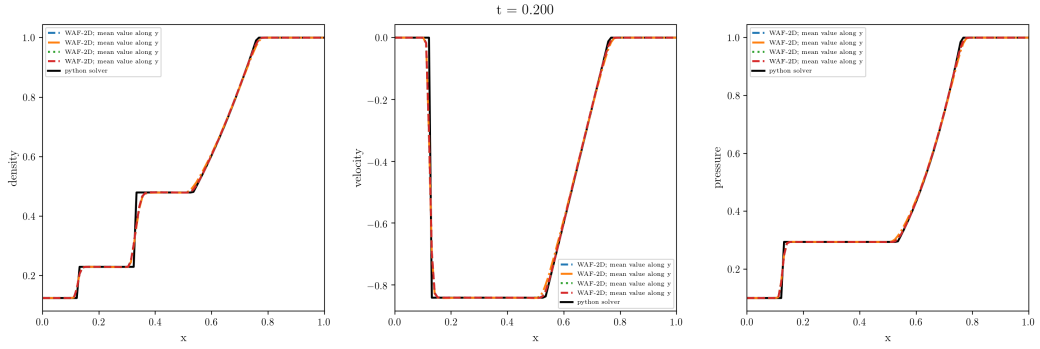

Figure 148: WAF method for (left facing) sod shock, MC flux limiter. Obtained result.

4.2.2 MINMOD limiter

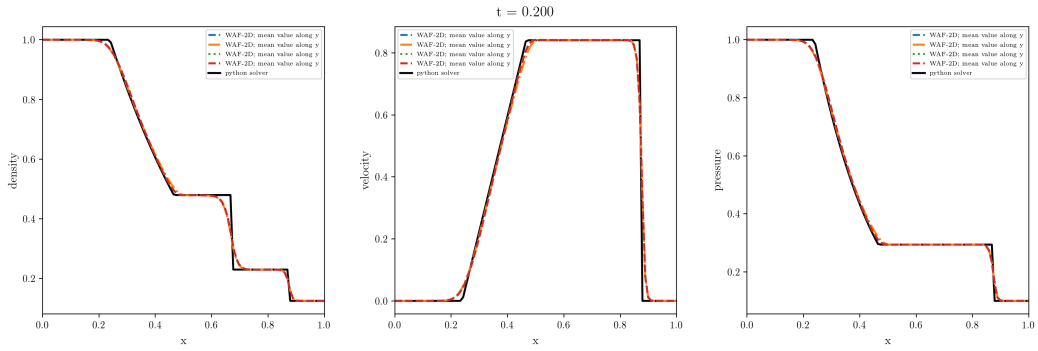

Figure 149: WAF method for (right facing) sod shock, MINMOD flux limiter. Expected result.

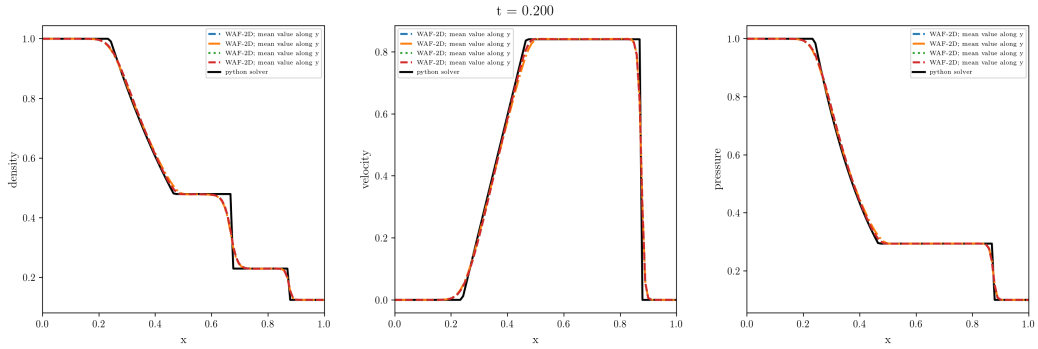

Figure 150: WAF method for (right facing) sod shock, MINMOD flux limiter. Obtained result.

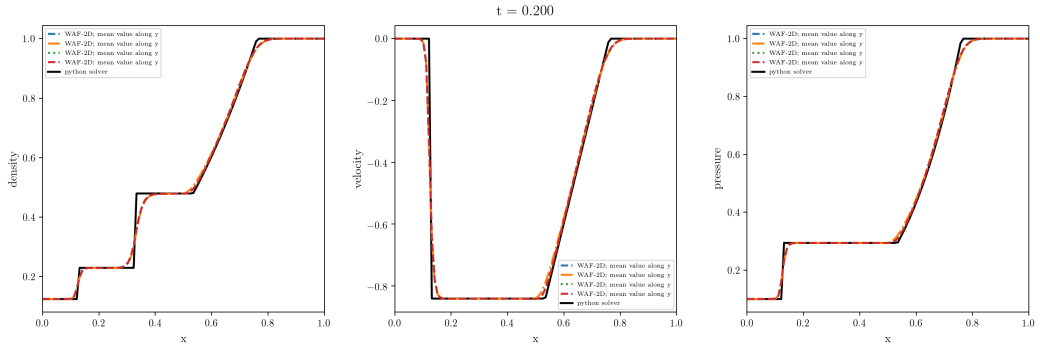

Figure 151: WAF method for (left facing) sod shock, MINMOD flux limiter. Expected result.

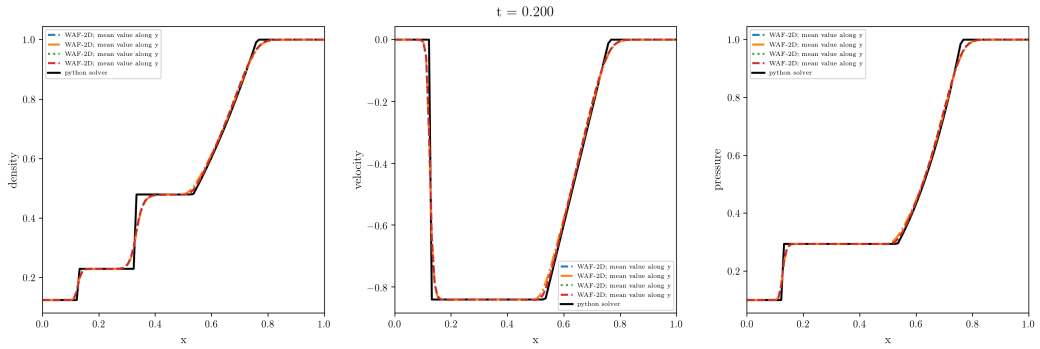

Figure 152: WAF method for (left facing) sod shock, MINMOD flux limiter. Obtained result.

4.2.3 van Leer limiter

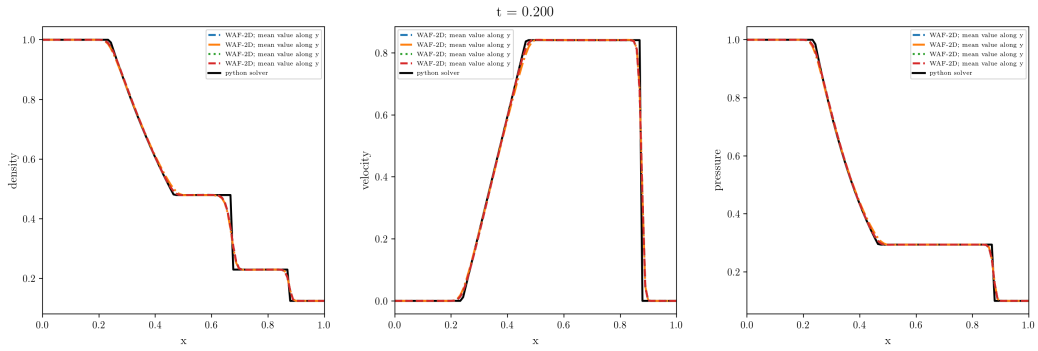

Figure 153: WAF method for (right facing) sod shock, van Leer flux limiter. Expected result.

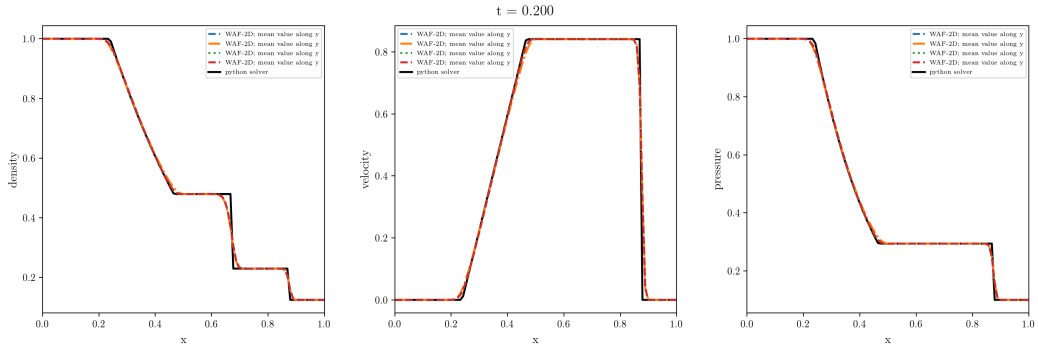

Figure 154: WAF method for (right facing) sod shock, van Leer flux limiter. Obtained result.

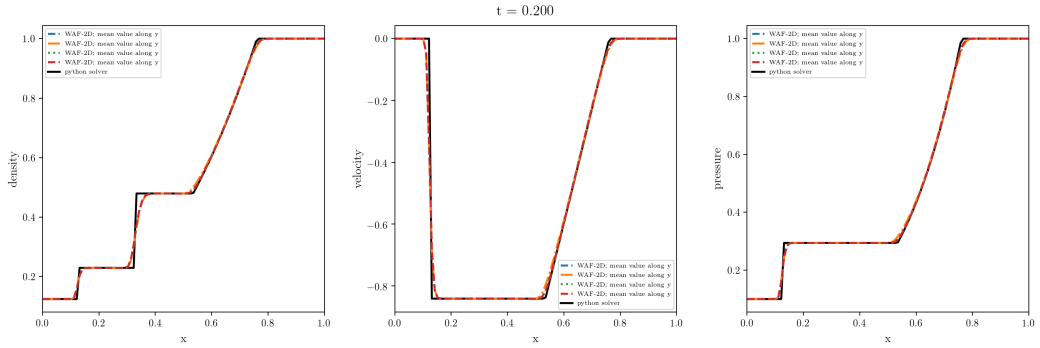

Figure 155: WAF method for (left facing) sod shock, van Leer flux limiter. Expected result.

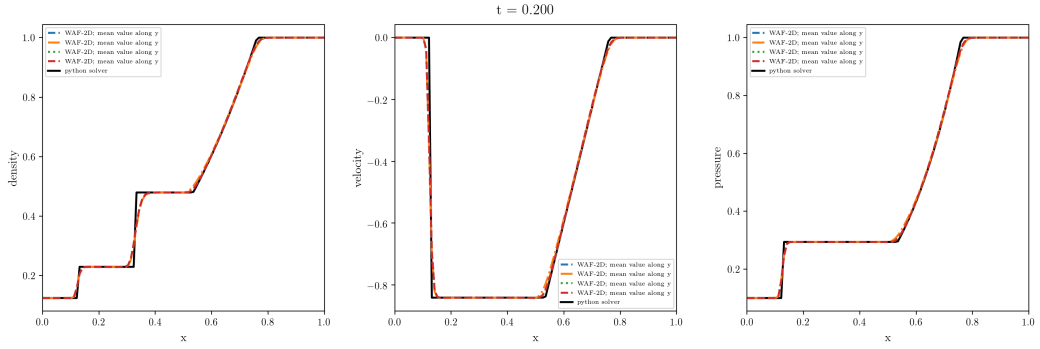

Figure 156: WAF method for (left facing) sod shock, van Leer flux limiter. Obtained result.

4.2.4 SUPERBEE limiter

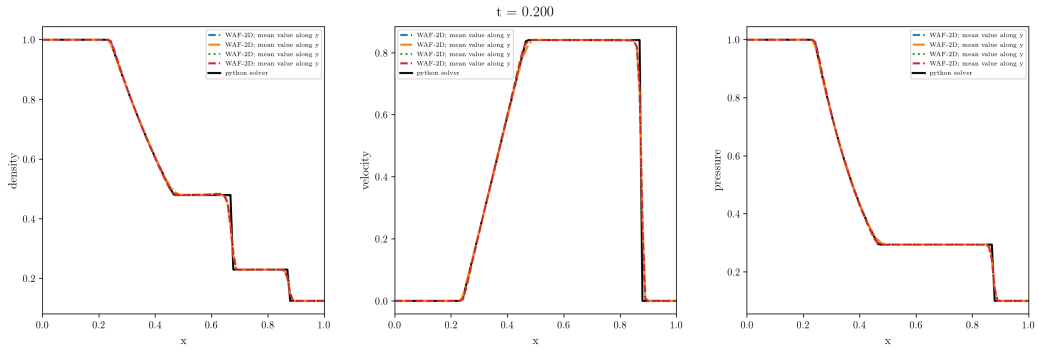

Figure 157: WAF method for (right facing) sod shock, SUPERBEE flux limiter. Expected result.

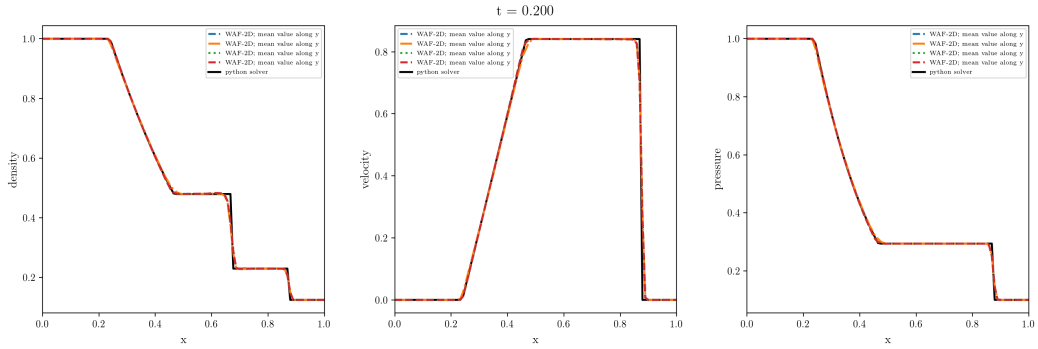

Figure 158: WAF method for (right facing) sod shock, SUPERBEE flux limiter. Obtained result.

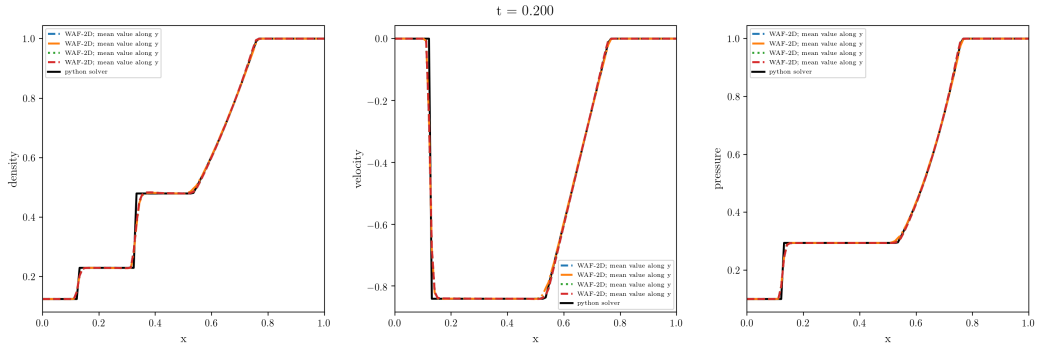

Figure 159: WAF method for (left facing) sod shock, SUPERBEE flux limiter. Expected result.

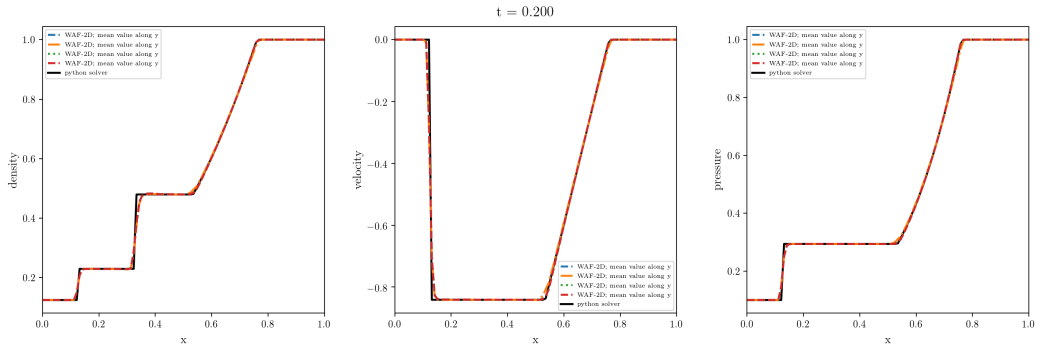

Figure 160: WAF method for (left facing) sod shock, SUPERBEE flux limiter. Obtained result.

4.3 Others in 2D

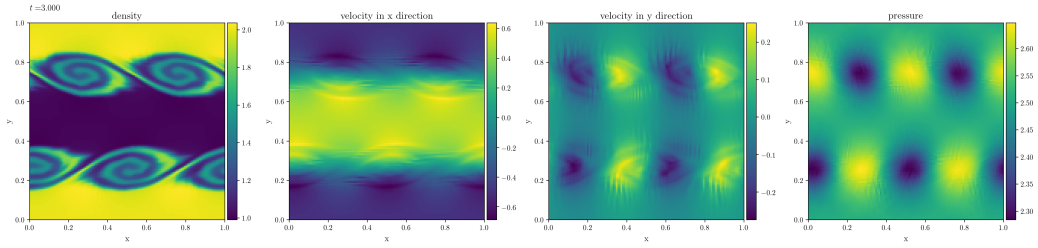

Figure 161: WAF method for Kelvin Helmholtz instability. Expected result with HLLC solver and van Leer limiter.

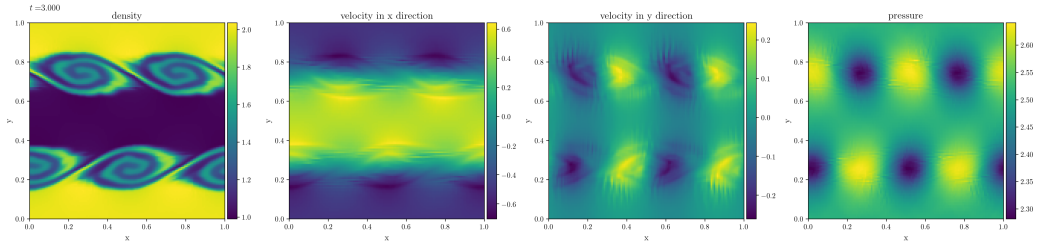

Figure 162: WAF method for Kelvin Helmholtz instability. Obtained result with HLLC solver and van Leer limiter.

5 MUSCL Method

5.1 1D with different Limiters

5.1.1 Without limiter

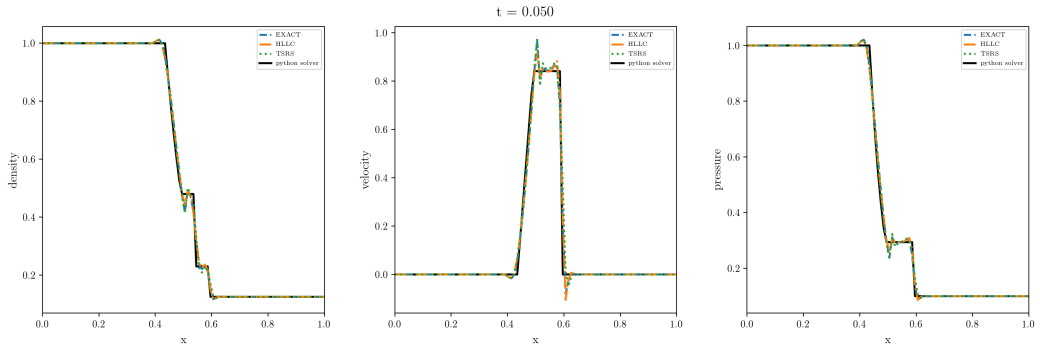

Figure 163: MUSCL method for (right facing) sod shock, no flux limiter. Expected result.

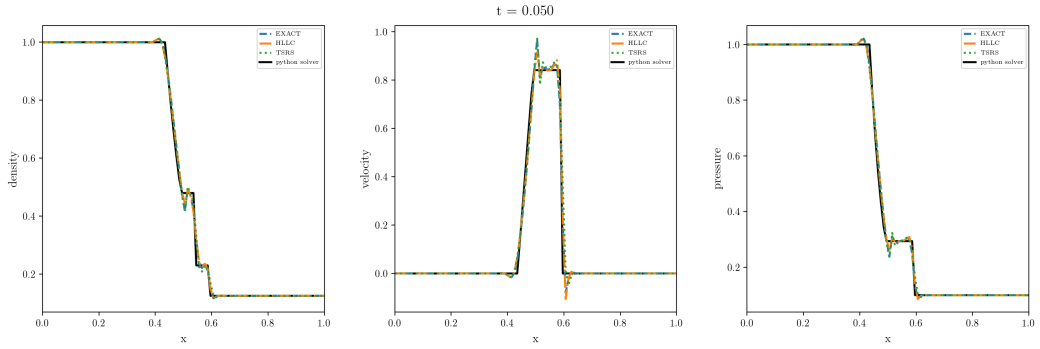

Figure 164: MUSCL method for (right facing) sod shock, no flux limiter. Obtained result.

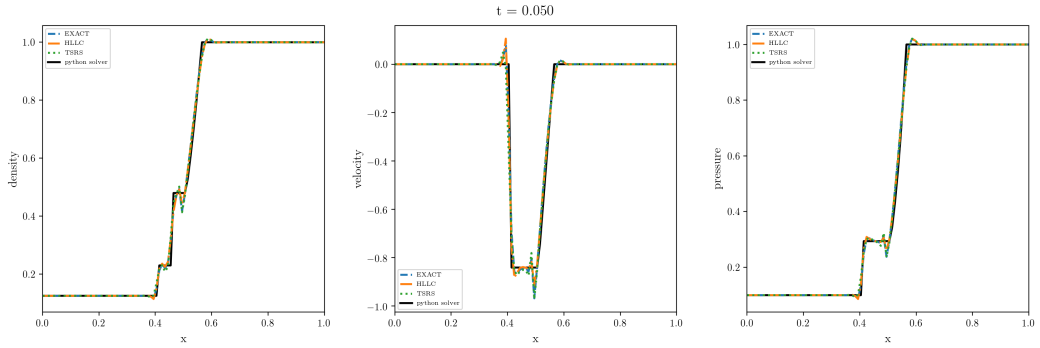

Figure 165: MUSCL method for (left facing) sod shock, no flux limiter. Expected result.

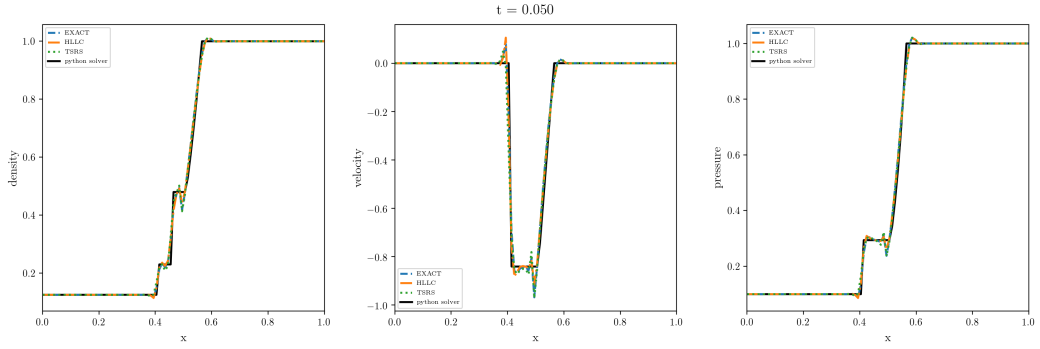

Figure 166: MUSCL method for (left facing) sod shock, no flux limiter. Obtained result.

5.1.2 MINMOD limiter

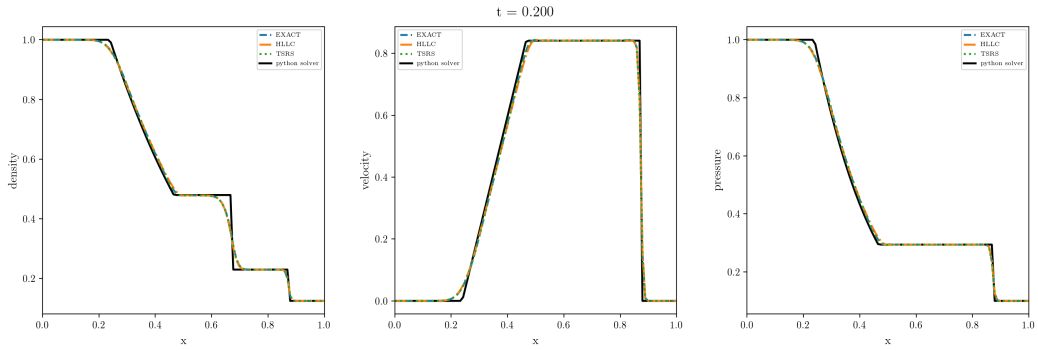

Figure 167: MUSCL method for (right facing) sod shock, MINMOD flux limiter. Expected result.

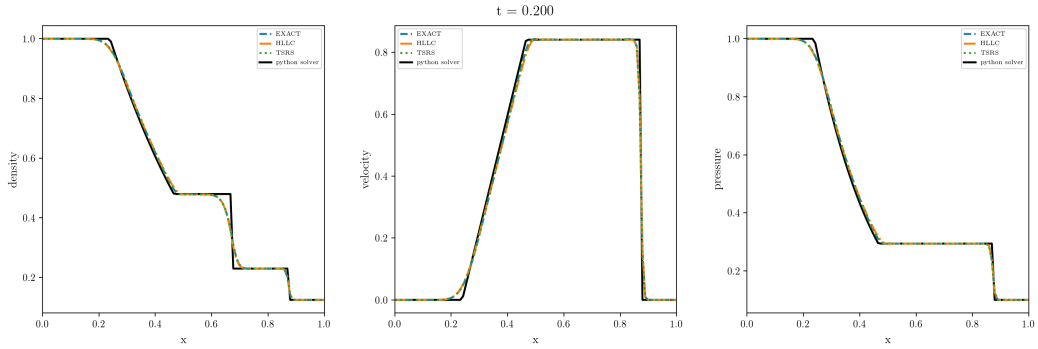

Figure 168: MUSCL method for (right facing) sod shock, MINMOD flux limiter. Obtained result.

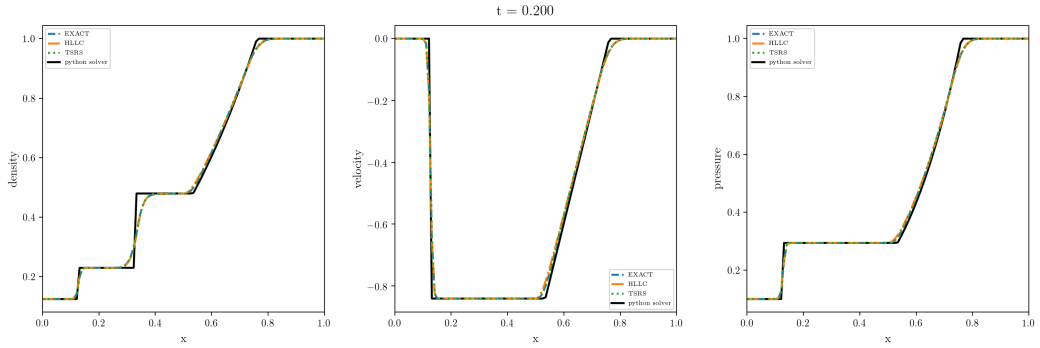

Figure 169: MUSCL method for (left facing) sod shock, MINMOD flux limiter. Expected result.

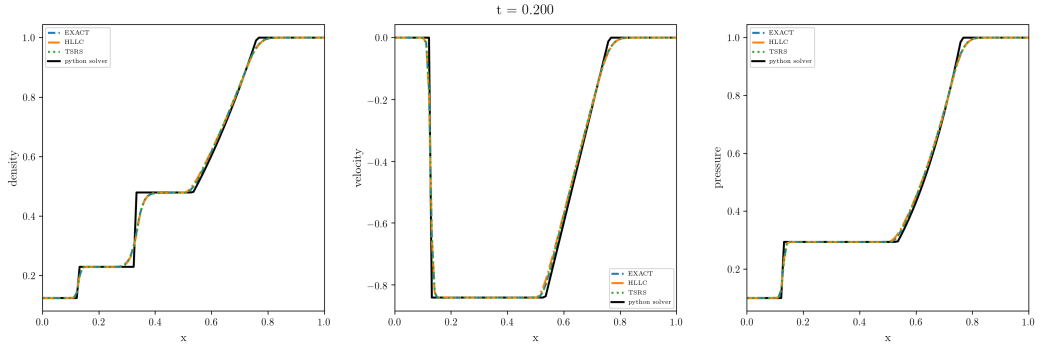

Figure 170: MUSCL method for (left facing) sod shock, MINMOD flux limiter. Obtained result.

5.1.3 van Leer limiter

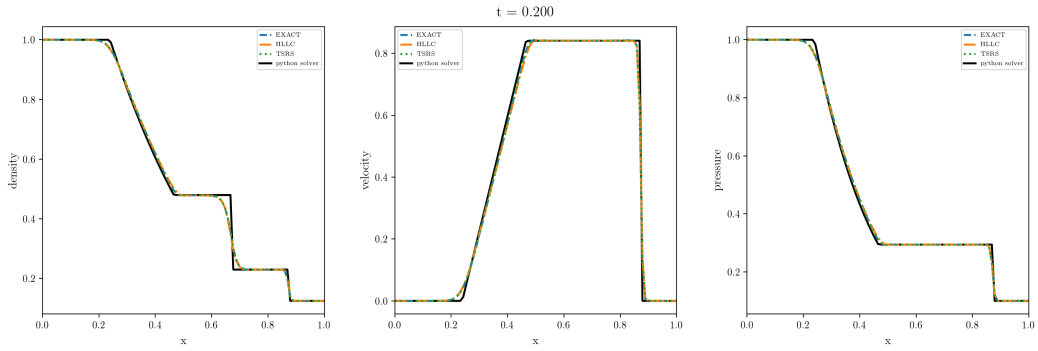

Figure 171: MUSCL method for (right facing) sod shock, van Leer flux limiter. Expected result.

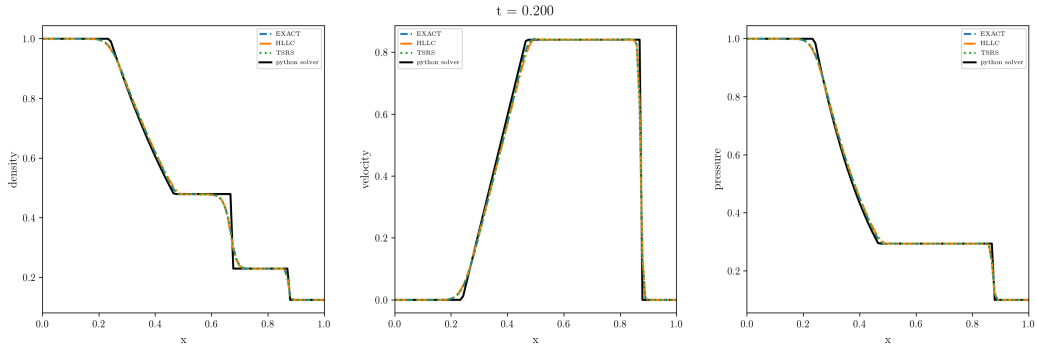

Figure 172: MUSCL method for (right facing) sod shock, van Leer flux limiter. Obtained result.

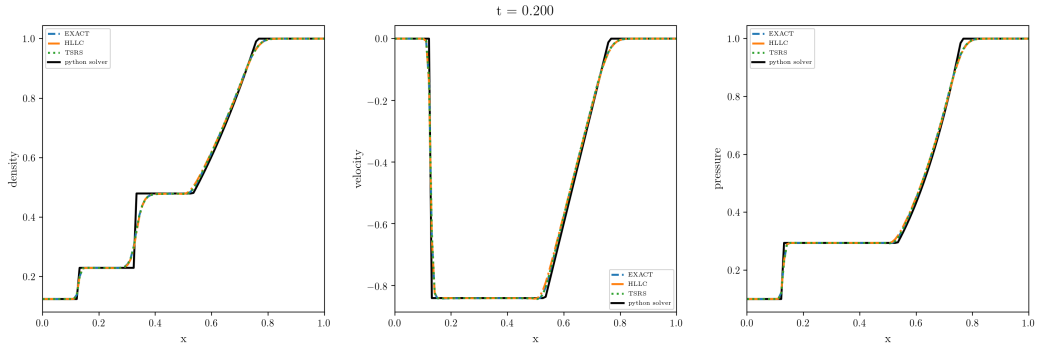

Figure 173: MUSCL method for (left facing) sod shock, van Leer flux limiter. Expected result.

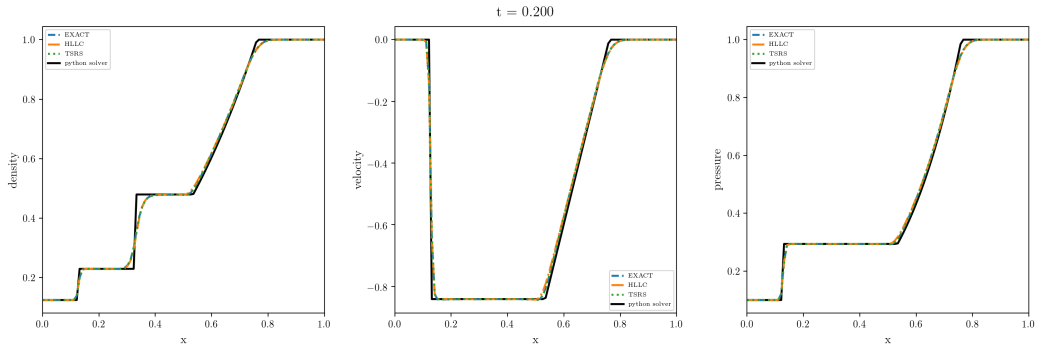

Figure 174: MUSCL method for (left facing) sod shock, van Leer flux limiter. Obtained result.

5.1.4 SUPERBEE limiter

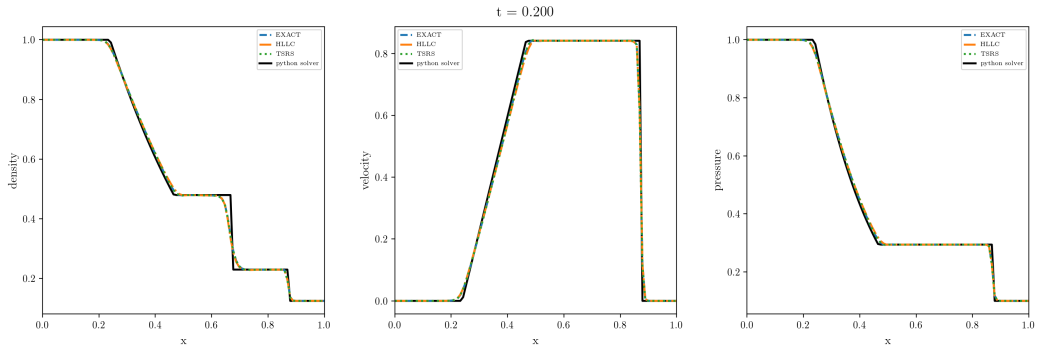

Figure 175: MUSCL method for (right facing) sod shock, SUPERBEE flux limiter. Expected result.

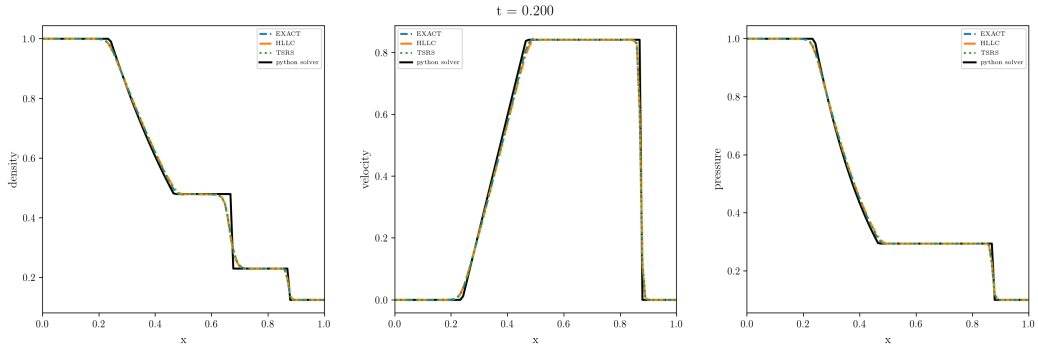

Figure 176: MUSCL method for (right facing) sod shock, SUPERBEE flux limiter. Obtained result.

5.2 2D with different Limiters

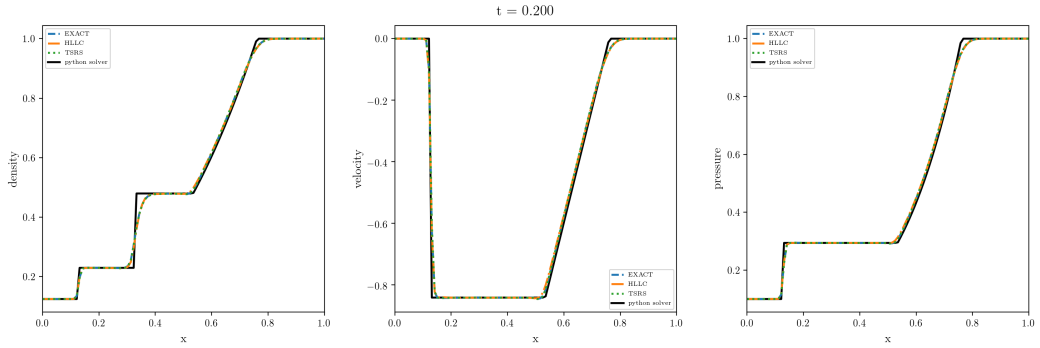

Figure 177: MUSCL method for (left facing) sod shock, SUPERBEE flux limiter. Expected result.

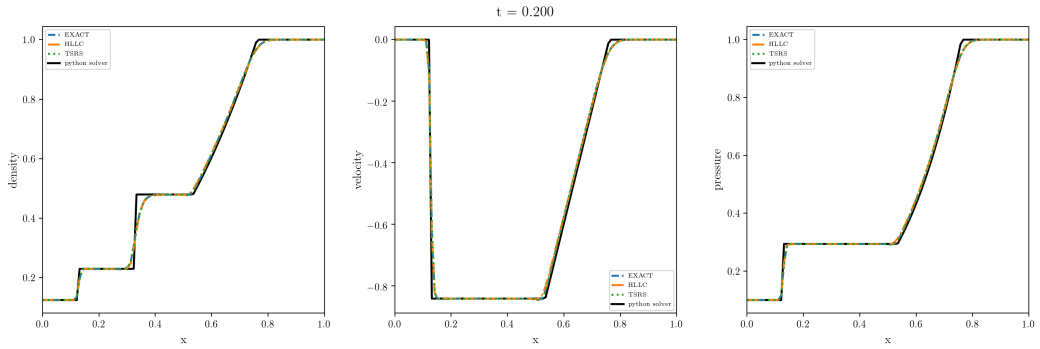

Figure 178: MUSCL method for (left facing) sod shock, SUPERBEE flux limiter. Obtained result.

5.2.1 MINMOD limiter

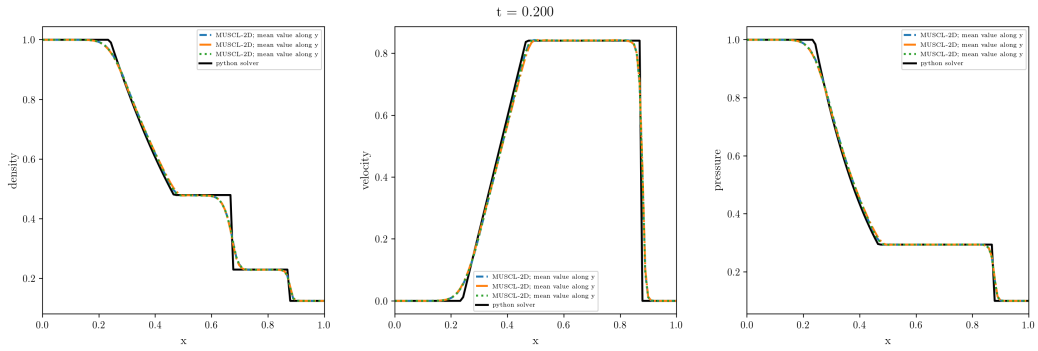

Figure 179: MUSCL method for (right facing) sod shock, MINMOD flux limiter. Expected result.

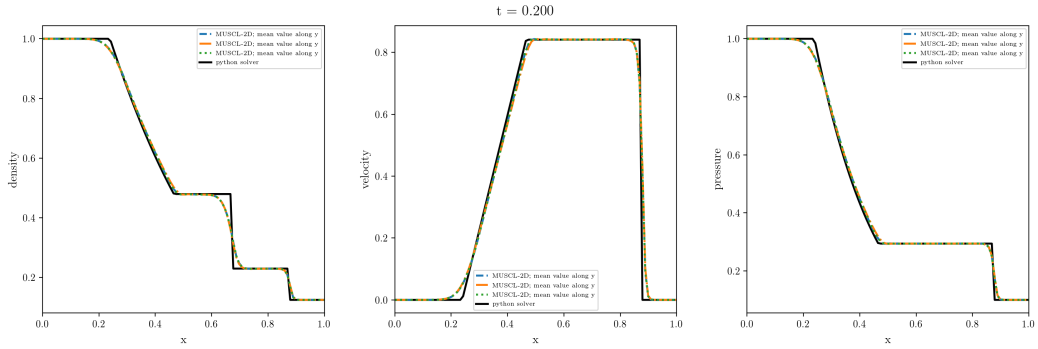

Figure 180: MUSCL method for (right facing) sod shock, MINMOD flux limiter. Obtained result.

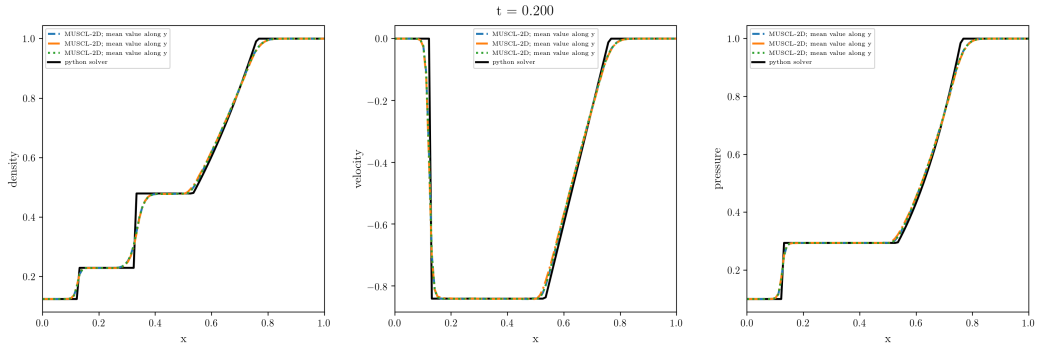

Figure 181: MUSCL method for (left facing) sod shock, MINMOD flux limiter. Expected result.

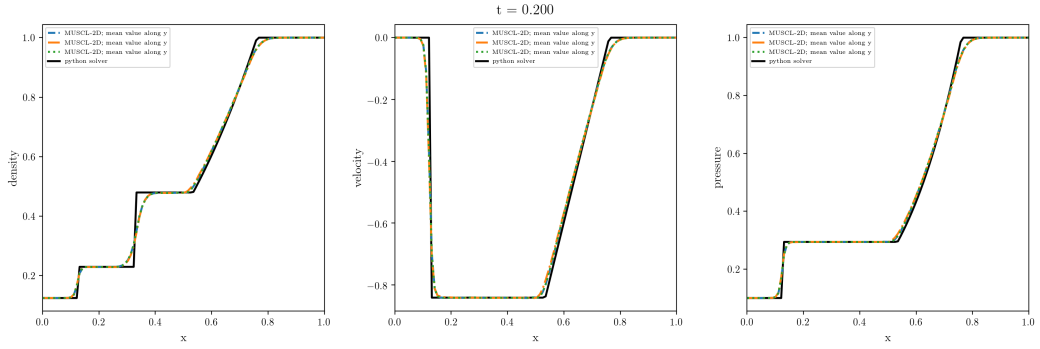

Figure 182: MUSCL method for (left facing) sod shock, MINMOD flux limiter. Obtained result.

5.2.2 van Leer limiter

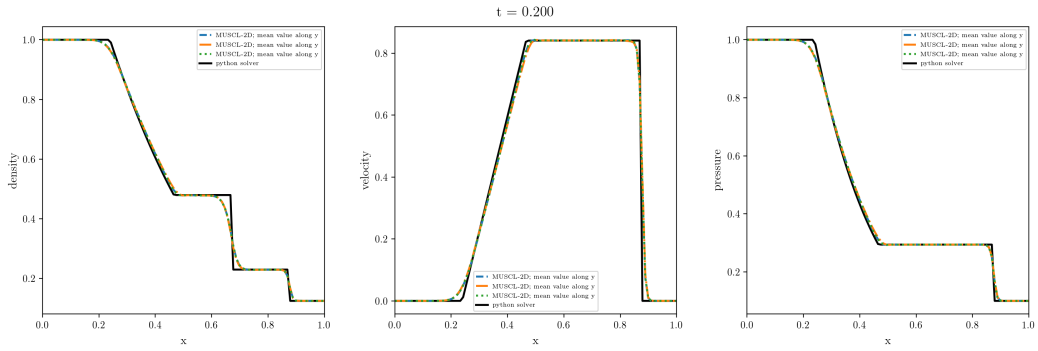

Figure 183: MUSCL method for (right facing) sod shock, van Leer flux limiter. Expected result.

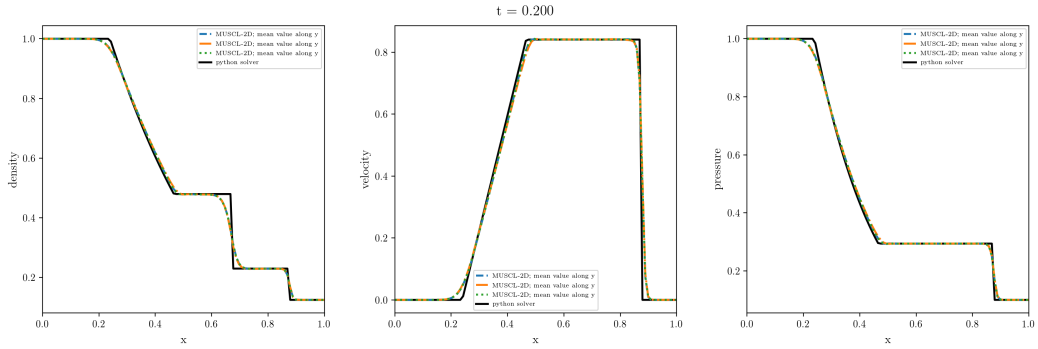

Figure 184: MUSCL method for (right facing) sod shock, van Leer flux limiter. Obtained result.

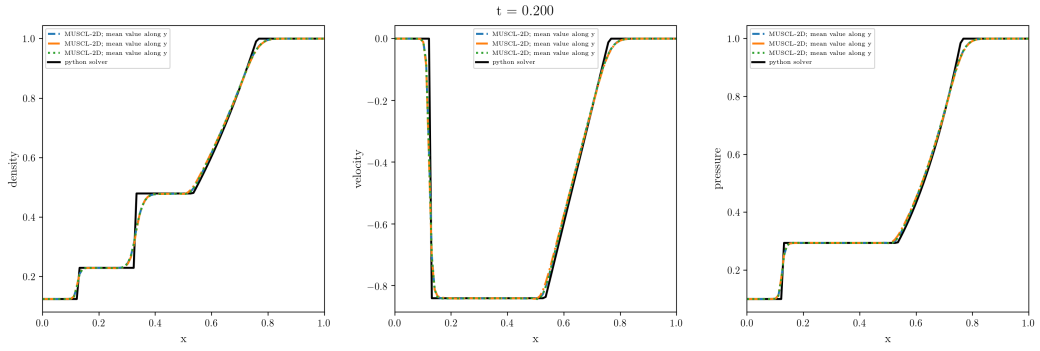

Figure 185: MUSCL method for (left facing) sod shock, van Leer flux limiter. Expected result.

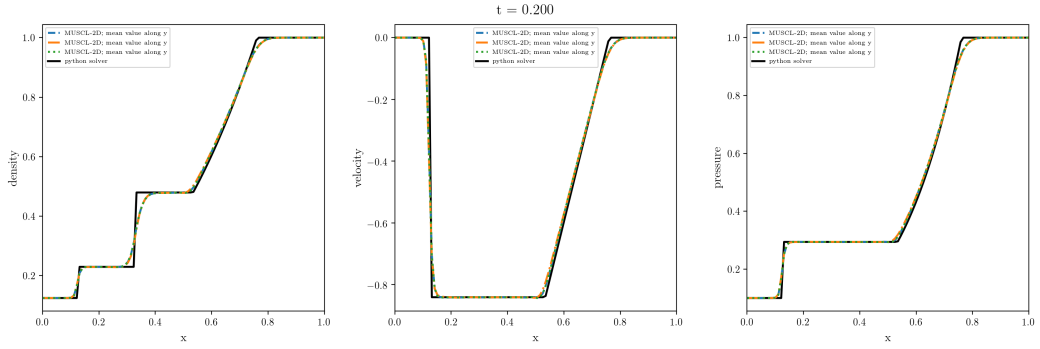

Figure 186: MUSCL method for (left facing) sod shock, van Leer flux limiter. Obtained result.

5.2.3 SUPERBEE limiter

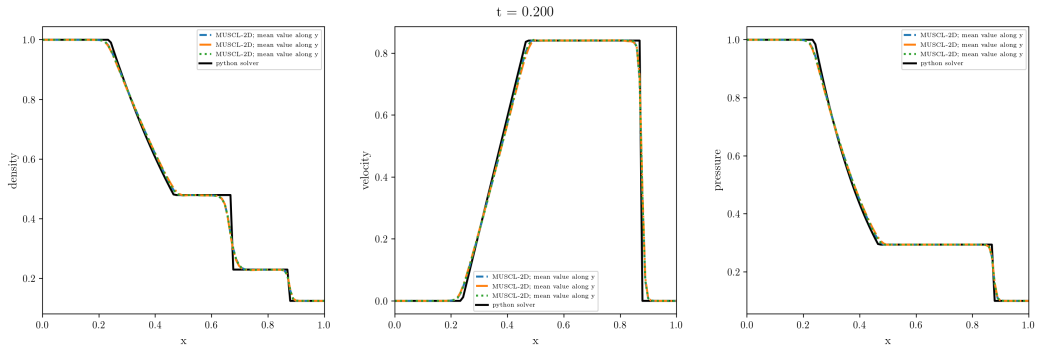

Figure 187: MUSCL method for (right facing) sod shock, SUPERBEE flux limiter. Expected result.

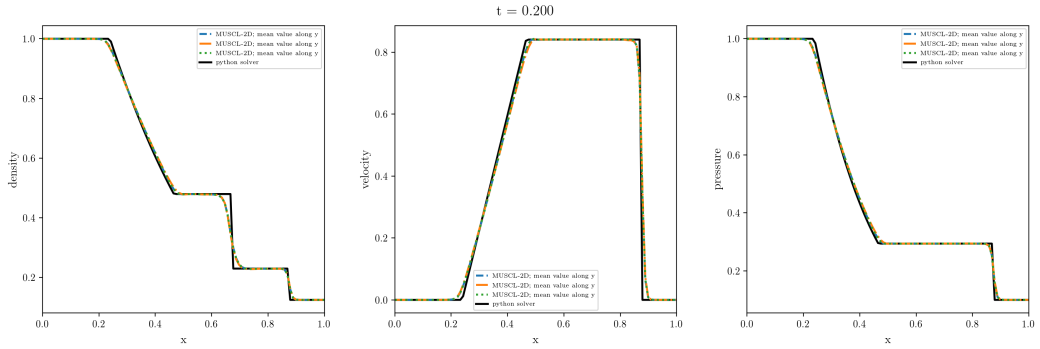

Figure 188: MUSCL method for (right facing) sod shock, SUPERBEE flux limiter. Obtained result.

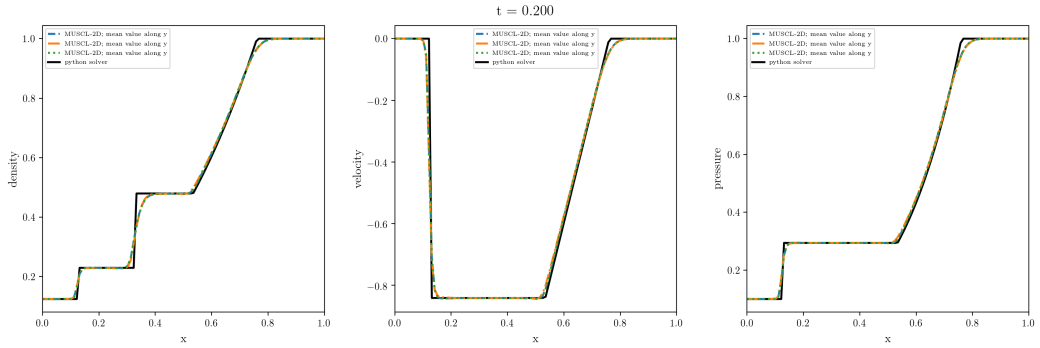

Figure 189: MUSCL method for (left facing) sod shock, SUPERBEE flux limiter. Expected result.

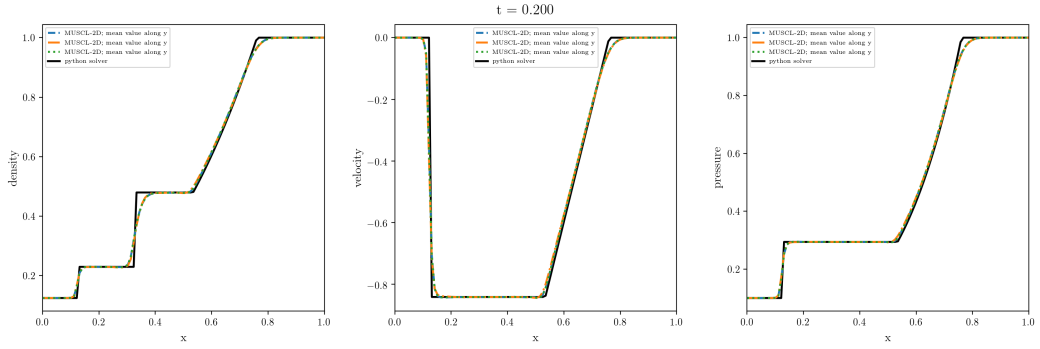

Figure 190: MUSCL method for (left facing) sod shock, SUPERBEE flux limiter. Obtained result.

5.3 Others in 2D

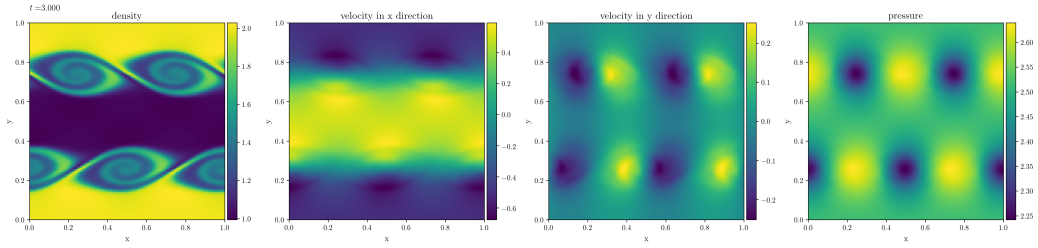

Figure 191: MUSCL method for Kelvin Helmholtz instability. Expected result with HLLC solver and van Leer limiter.

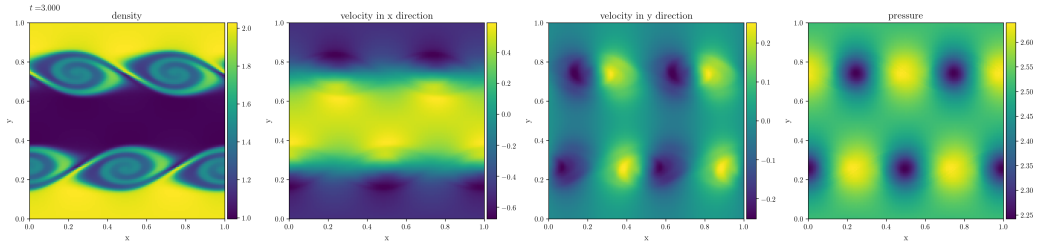

Figure 192: MUSCL method for Kelvin Helmholtz instability. Obtained result with HLLC solver and van Leer limiter.

6 Source Terms

6.1 Constant

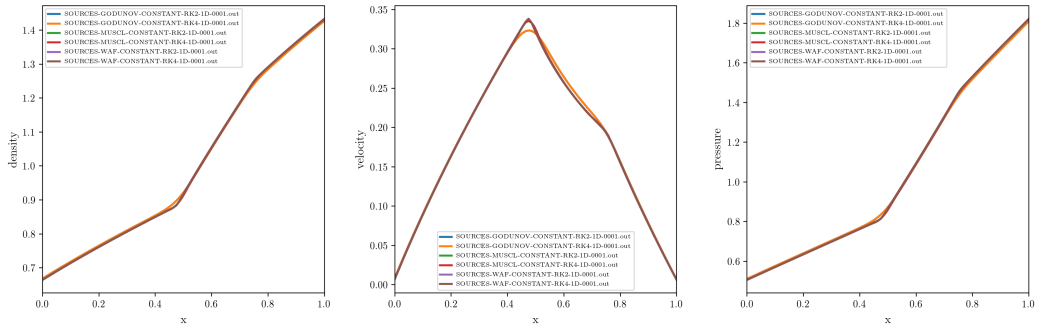

Figure 193: Constant source terms in 1D for various solvers, expected result

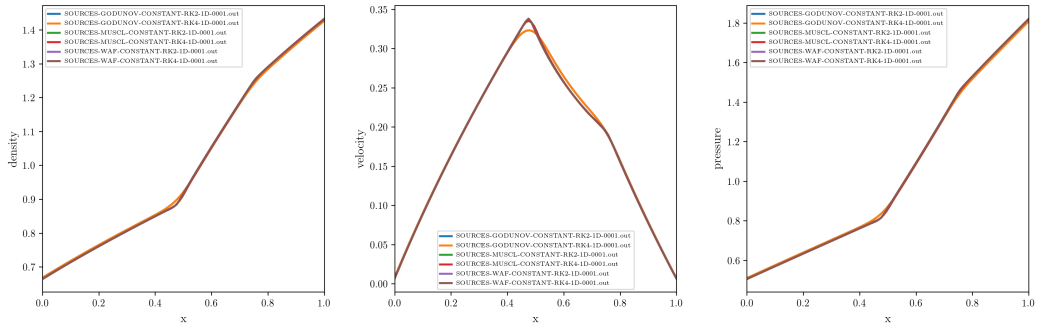

Figure 194: Constant source terms in 1D for various solvers, obtained result

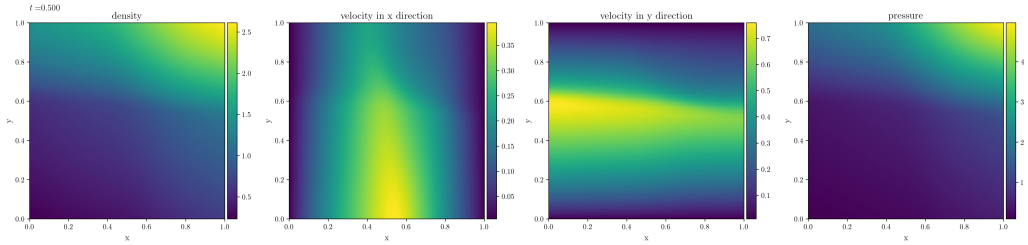

Figure 195: Constant source terms in 2D for GODUNOV solvers and RK2 integrator, expected result

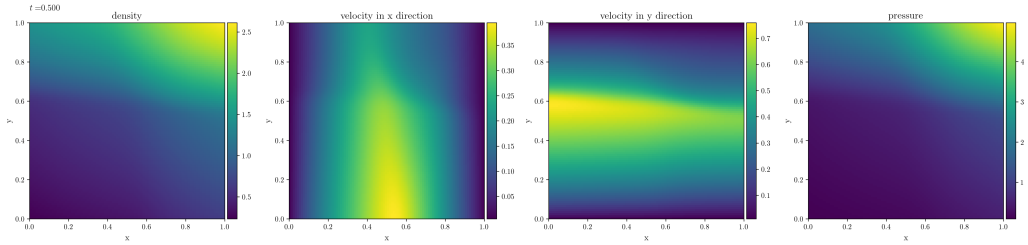

Figure 196: Constant source terms in 2D for GODUNOV solvers and RK2 integrator, obtained result

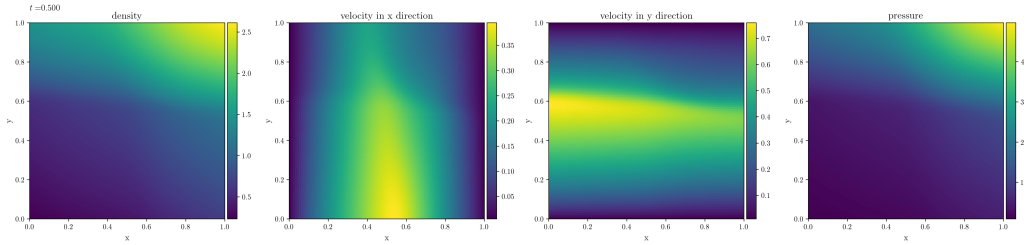

Figure 197: Constant source terms in 2D for GODUNOV solver and RK4 integrator, expected result

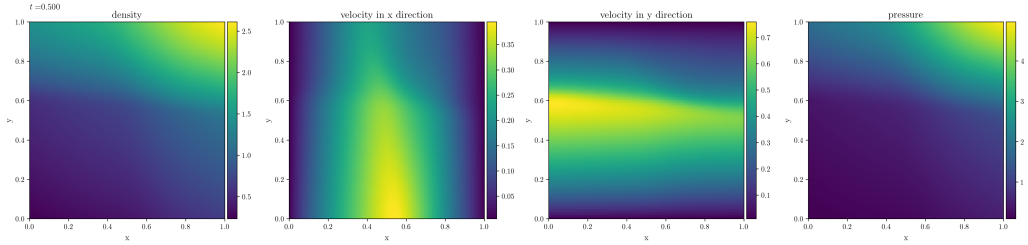

Figure 198: Constant source terms in 2D for GODUNOV solver and RK4 integrator, obtained result

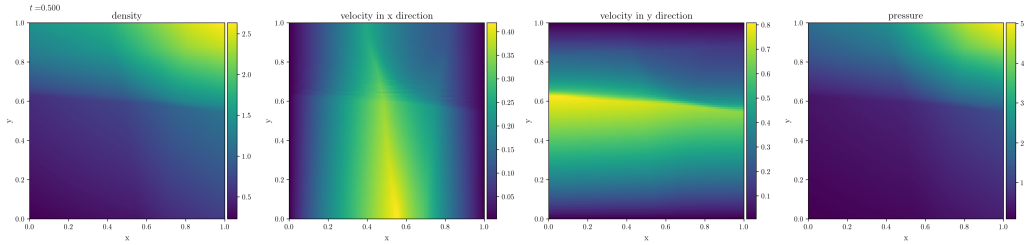

Figure 199: Constant source terms in 2D for WAF solver and RK2 integrator, expected result

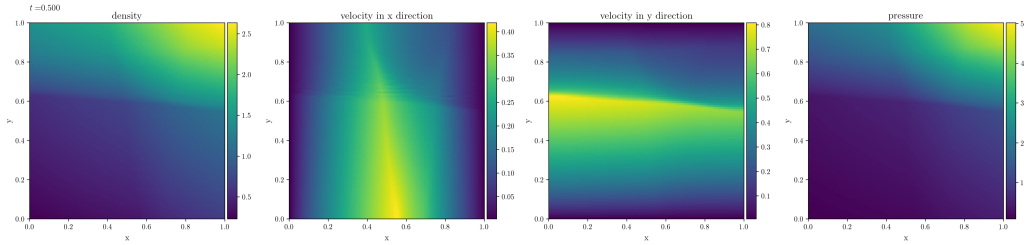

Figure 200: Constant source terms in 2D for WAF solver and RK2 integrator, obtained result

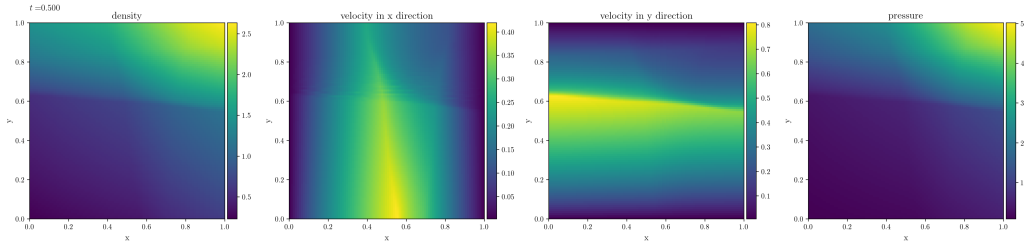

Figure 201: Constant source terms in 2D for WAF solver and RK4 integrator, expected result

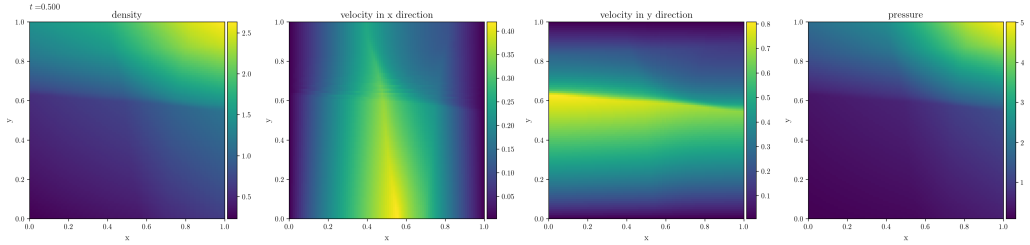

Figure 202: Constant source terms in 2D for WAF solver and RK4 integrator, obtained result

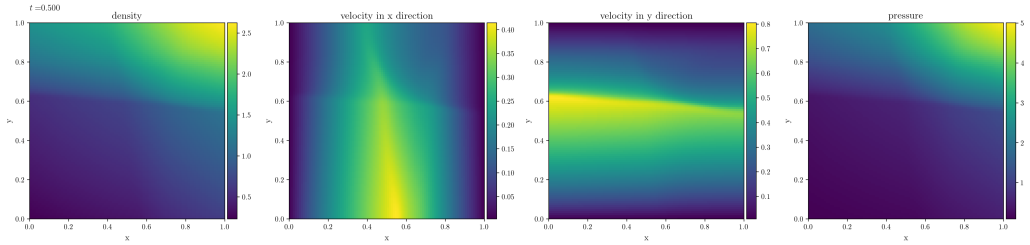

Figure 203: Constant source terms in 2D for MUSCL solver and RK2 integrator, expected result

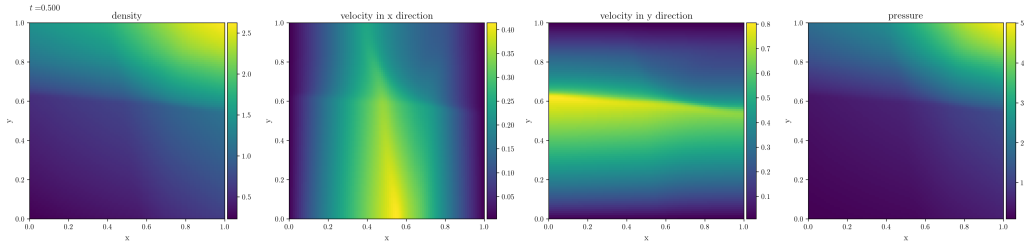

Figure 204: Constant source terms in 2D for MUSCL solver and RK2 integrator, obtained result

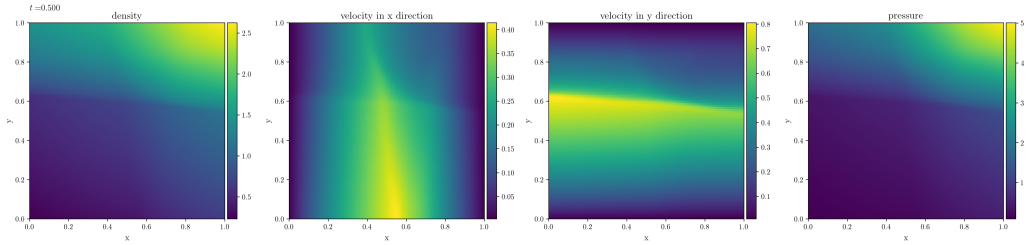

Figure 205: Constant source terms in 2D for MUSCL solver and RK4 integrator, expected result

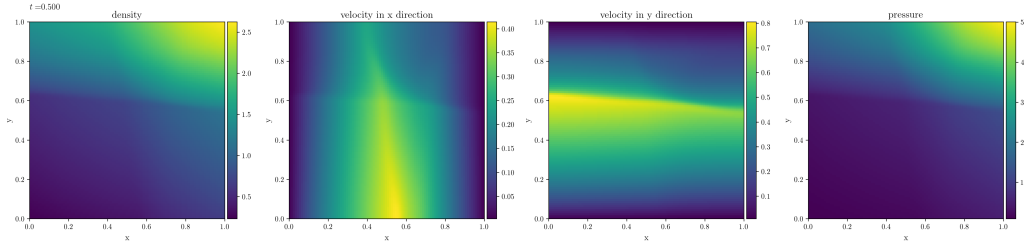

Figure 206: Constant source terms in 2D for MUSCL solver and RK4 integrator, obtained result

6.2 Radial

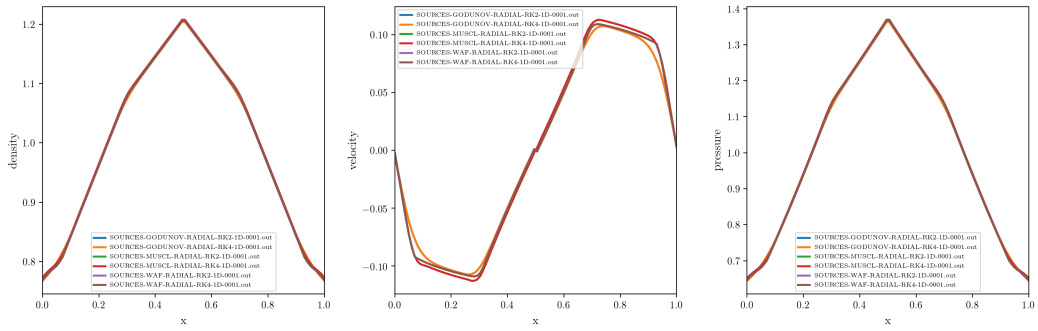

Figure 207: Radial source terms in 1D for various solvers, expected result

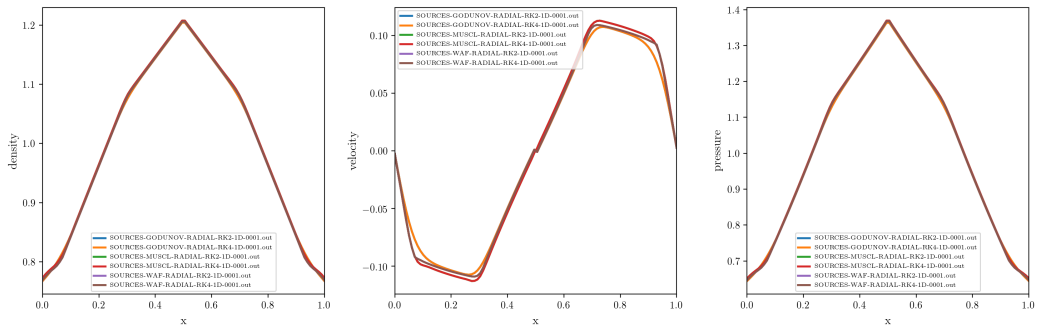

Figure 208: Radial source terms in 1D for various solvers, obtained result

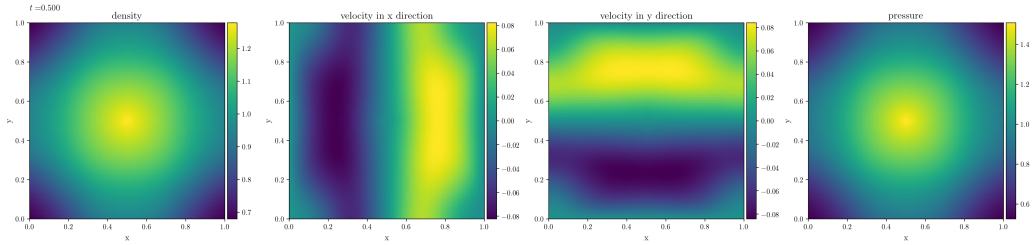

Figure 209: Radial source terms in 2D for GODUNOV solvers and RK2 integrator, expected result

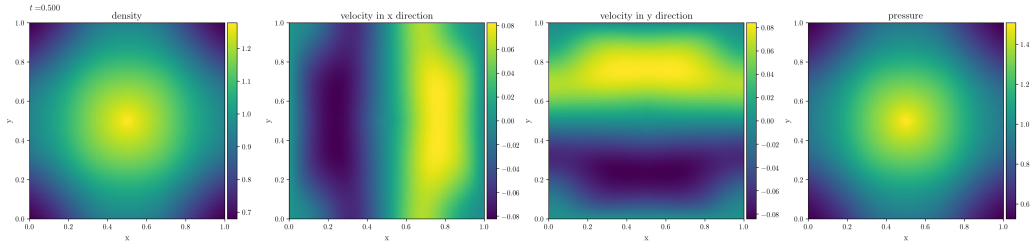

Figure 210: Radial source terms in 2D for GODUNOV solvers and RK2 integrator, obtained result

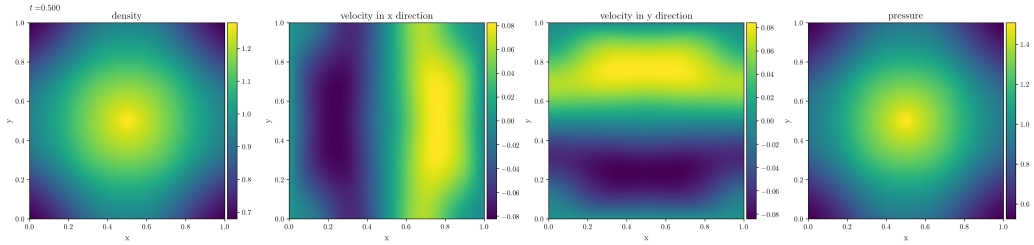

Figure 211: Radial source terms in 2D for GODUNOV solver and RK4 integrator, expected result

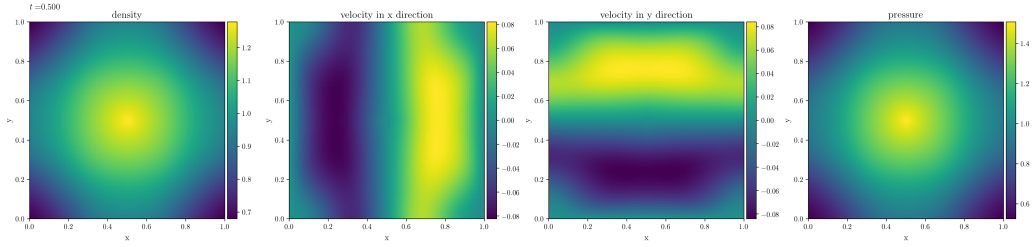

Figure 212: Radial source terms in 2D for GODUNOV solver and RK4 integrator, obtained result

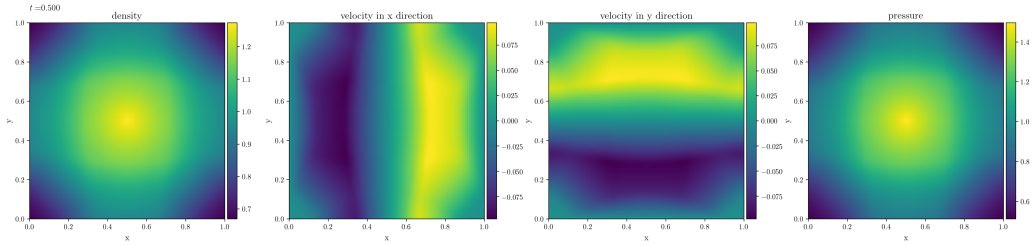

Figure 213: Radial source terms in 2D for WAF solver and RK2 integrator, expected result

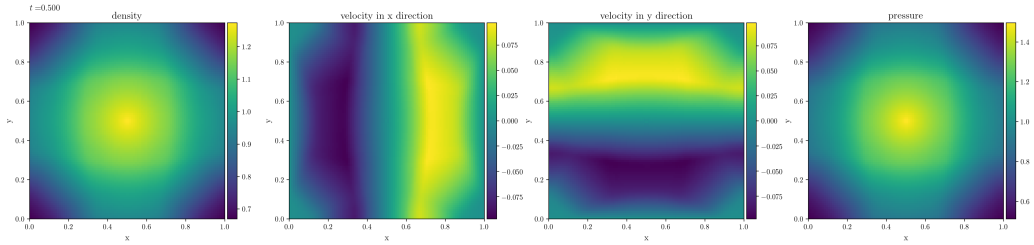

Figure 214: Radial source terms in 2D for WAF solver and RK2 integrator, obtained result

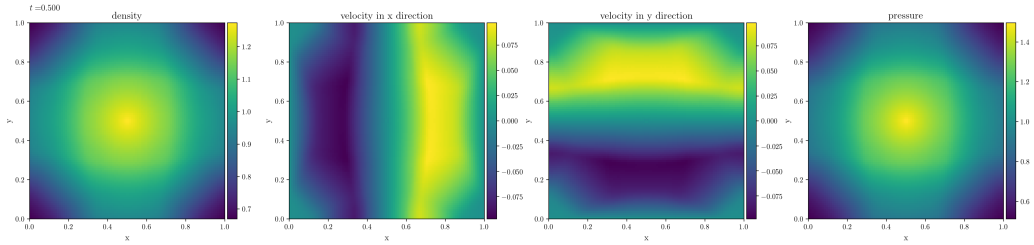

Figure 215: Radial source terms in 2D for WAF solver and RK4 integrator, expected result

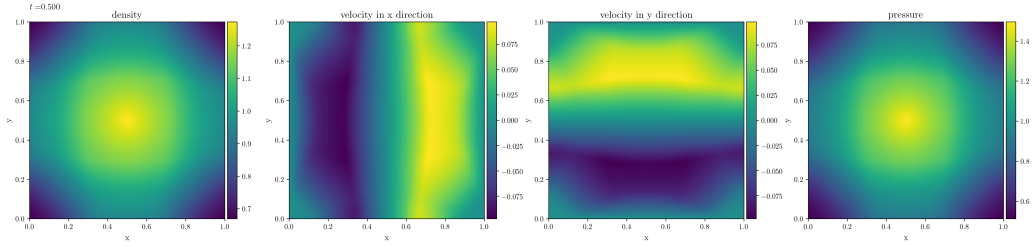

Figure 216: Radial source terms in 2D for WAF solver and RK4 integrator, obtained result

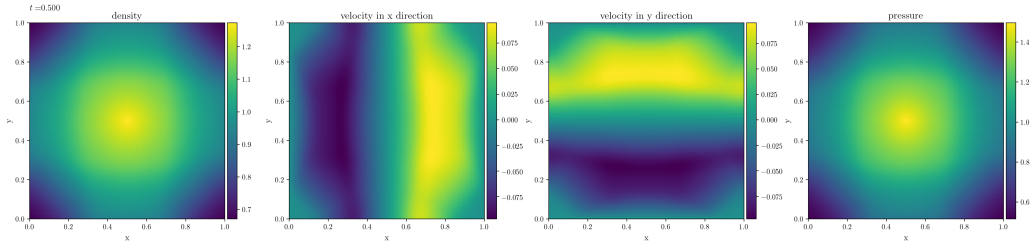

Figure 217: Radial source terms in 2D for MUSCL solver and RK2 integrator, expected result

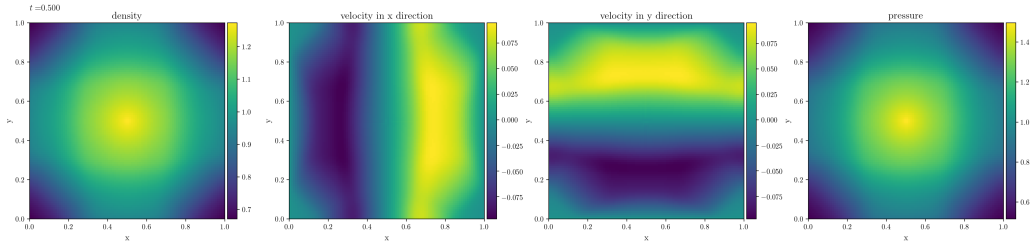

Figure 218: Radial source terms in 2D for MUSCL solver and RK2 integrator, obtained result

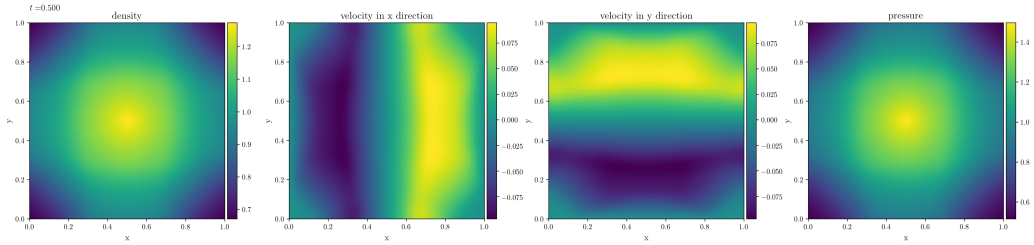

Figure 219: Radial source terms in 2D for MUSCL solver and RK4 integrator, expected result

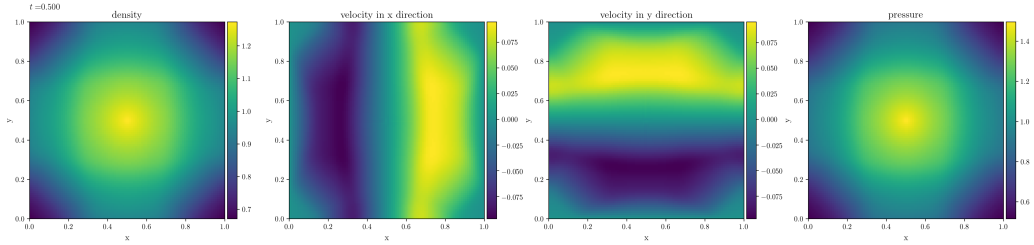

Figure 220: Radial source terms in 2D for MUSCL solver and RK4 integrator, obtained result