Figure 1. The schematic graph and spray image of the outward-opening piezoelectric injector.

Figure 2. Simulation meshes with different mesh sizes (1st row) and the mesh with consideration of the geometry of the injector (2nd row).

Figure 3. Effect of mesh size on the spray penetration with KHRT model (B0 = 0.61, B1 = 40, C3 = 0.5 and Cτ=1).

Figure 4. Effect of mesh size on the droplet distribution at (a) 1 bar and (b) 10 bar back pressure with KHRT model (B0 = 0.61, B1 = 40, C3 = 0.5 and Cτ=1).

Figure 5. Effect of mesh size on the SMD at (a) 1 bar and (b) 10 bar back pressure with KHRT model (B0 = 0.61, B1 = 40, C3 = 0.5 and Cτ=1).

Figure 6. Effect of mesh size on the spray penetration with Reitz-Diwakar model, (Cb1 = 8.4, Cb2 =π, Cs1= 0.5 and Cs2 = 20).

Figure 7. Effect of mesh size on the droplet distribution at (a) 1 bar and (b) 10 bar backpressures with Reitz-Diwakar model, (Cb1 = 8.4, Cb2 =π, Cs1= 0.5 and Cs2 = 20).

Figure 8. Effect of mesh size on the SMD at (a) 1 bar and (b) 10 bar backpressures with Reitz-Diwakar model, (Cb1 = 8.4, Cb2 =π, Cs1= 0.5 and Cs2 = 20).

Figure 9. Comparison of the spray penetration w/o and w/t injector geometry in the mesh (KHRT model: B0 = 0.61, B1 = 40, C3 = 0.5 and Cτ=1).

Figure 10. The SMD and droplet distribution (@ 1 ms) with the mesh w/t and w/o injector geometry at 10 bar back pressure (KHRT model: B0 = 0.61, B1 = 40, C3 = 0.5 and Cτ=1).

Figure 11. Comparison of the spray penetration w/o and w/t injector geometry in the mesh (Reitz-Diwakar model: Cb1 = 8.4, Cb2 =π, Cs1= 0.5 and Cs2 = 20).

Figure 12. Effect of simulation time step on the spray penetration with KHRT model (B0 = 0.61, B1 = 40, C3 = 0.5 and Cτ=1).

Figure 13. Effect of simulation time step on the spray penetration with Reitz-Diwakar model, (Cb1 = 8.4, Cb2 =π, Cs1= 0.5 and Cs2 = 20).

Figure 14. Effect of constant B1 on (a) spray penetration and (b) SMD with KHRT model (B0 = 0.61, C3 = 0.5 and Cτ=1).

Figure 15. Effect of constant C3 on (a) spray penetration and (b) SMD with KHRT model (B0 = 0.61, B1 = 40 and Cτ=1).

Figure 16. Comparison of the (a) spray penetration, (b) SMD at 1 bar backpressure and (c) SMD at 10 bar backpressure with different B1 and C3 (KHRT model: B0 = 0.61 and Cτ=1).

Figure 17. Comparison of the droplet distributions with different B1 and C3 at (a) 1 bar and (b) 10 bar backpressure (KHRT model: B0 = 0.61 and Cτ=1).

Figure 18. Effect of constants Cb1 on (a) spray penetration and (b) SMD with Reitz-Diwakar model, (Cb2 =π, Cs1= 0.5 and Cs2 = 20).

Figure 19. Effect of constant Cs2 on (a) spray penetration, (b) SMD and droplets and fuel concentration (0-5%) distributions with Reitz-Diwakar model, (Cb1 = 8.4, Cb2 =π and Cs1= 0.5).

Figure 20. Comparison of the SMD at 10 bar backpressure with KHRT (B0 = 0.61 and Cτ=1) and Reitz-Diwakar model (Cb2 =π and Cs1= 0.5).

Figure 21. Comparison of fuel vapor concentration (left) and velocity distributions (right) at 0.8 ms at 10 bar backpressure with KHRT (B0 = 0.61 and Cτ=1) and Reitz-Diwakar model (Cb2 =π and Cs1= 0.5).

Table 1. Numerical models