

Publications

Thesis

- [1] M. Klein. *Towards LES as an Engineering Tool*, Habilitation, Technische Universität Darmstadt. 2009.
- [2] M. Klein. *Direkte Numerische Simulation des primären Strahlzerfalls in Einstoffzerstäuberdüsen*. PhD thesis, Technische Universität Darmstadt, 2002.

Journal Articles

- [3] E. Ruiz-Gutierrez, J. Hasslberger, M. Klein, K. Dalgarno, and N. Chakraborty. Physically consistent modelling of surface tension forces in the volume-of-fluid method for three or more phases. *Journal of Computational Physics*, 2024, accepted.
- [4] Karthick Rajkumar, Tony Di Fabbio, Eike Tangermann, and Markus Klein. Physical aspects of vortex-shock dynamics in delta-wing configurations. *Physics of Fluids*, 2024, accepted.
- [5] Benjamin Blau, Oscar Krzeczek, Christoph Heinrich, and Markus Klein. Analysis of water-in-gasoline emulsions using experiments and direct numerical simulations. *Experimental and Computational Multiphase Flow*, 2024, accepted.
- [6] Riccardo Concetti, Josef Hasslberger, Thomas Sattelmayer, and Markus Klein. On the chemical effect of steam addition to premixed hydrogen flames with respect to NO_x emissions and flame speed. *Flow Turbulence and Combustion*, 2024, accepted.
- [7] Riccardo Concetti, Josef Hasslberger, Nilanjan Chakraborty, and Markus Klein. Effects of liquid water injection on flame surface topology and propagation characteristics in spray flames: A direct numerical simulation analysis. *Physics of Fluids*, 2024, accepted.
- [8] Elias Trautner, Josef Hasslberger, Paolo Cifani, and Markus Klein. Enforcing accurate volume conservation in VOF-based long-term simulations of turbulent bubble-laden flows on coarse grids. *International Journal for Numerical Methods in Fluids*, 2024, accepted.
- [9] Tony Di Fabbio, Karthick Rajkumar, Eike Tangermann, and Markus Klein. Towards the understanding of vortex breakdown for improved RANS turbulence modeling. *Aerospace Science and Technology*, 2024, accepted.
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- [11] M. Klein. Integral turbulent length and time scales of higher order moments. *Flow Turbulence and Combustion*, 2023, accepted.
- [12] E. Ruiz-Gutierrez, J. Hasslberger, M. Klein, K. Dalgarno, and N. Chakraborty. Analysis and optimisation of mixing in binary droplet collisions. *Journal of Fluid Mechanics*, 2023, accepted.
- [13] S. Lomada, M. Pfitzner, and M. Klein. Flame surface density and artificially thickened flame combustion models applied to a turbulent partially-premixed flame. *Flow Turbulence and Combustion*, 111, 2023, accepted.
- [14] K. Rajkumar, E. Tangermann, and M. Klein. Efficient scale-resolving simulations of open cavity flows for straight and sideslip conditions. *Fluids*, 8:227, 2023.

- [15] P. Wenig, S. Kelm, and M. Klein. CFD uncertainty quantification using PCE-HDMR - exemplary application to a buoyancy-driven mixing process. *Flow Turbulence and Combustion*, 2023, accepted.
- [16] M. Pfitzner, J. Shin, and M. Klein. A priori validation of a multidimensional turbulent premixed combustion model for high-pressure Bunsen flames. *Combustion Science and Technology*, 2023, accepted.
- [17] L. Engelmann, J. Hasslberger, S.-J. Baik, M. Klein, and A. Kempf. Direct numerical simulation of an unsteady wall-bounded turbulent flow configuration for the assessment of large-eddy simulation models. *Scientific Reports*, 13:11202, 2023.
- [18] E. Tangermann and M. Klein. On hybrid RANS-LES of transition in a separated boundary layer. *International Journal of Heat and Fluid Flow*, 103:109188, 2023.
- [19] U. Ahmed, N. Chakraborty, and M. Klein. Influence of flow configuration and thermal wall boundary conditions on turbulence during premixed flame-wall interaction within low Reynolds number boundary layers. *Flow, Turbulence and Combustion*, 111, 2023.
- [20] P. Wenig, S. Kelm, and M. Klein. CFD uncertainty quantification using stochastic spectral methods - exemplary application to a buoyancy-driven mixing process. *Nuclear Engineering and Design*, 409:112317, 2023.
- [21] O. Krzeczek, T. Trummler, E. Trautner, and M. Klein. Effect of the density ratio on emulsions and their segregation: A direct numerical simulation study. *Energies*, 16:3160, 2023.
- [22] T. Di Fabbio, E. Tangermann, and M. Klein. Analysis of the vortex dominated flow field over a delta wing at transonic speed. *The Aeronautical Journal*, 2023, accepted.
- [23] V. Mohan, M. Herbert, M. Klein, and N. Chakraborty. A direct numerical simulation assessment of turbulent burning velocity parametrizations for non-unity Lewis numbers. *Energies*, 16:2590, 2023.
- [24] A. Begemann, T. Trummler, A. Doehring, M. Pfitzner, and M. Klein. Assessment of the thermodynamic and numerical modeling of LES of multi-component jet mixing at high pressure. *Energies*, 16:2113, 2023.
- [25] M. Bambauer, J. Hasslberger, G. Ozel-Erol, N. Chakraborty, and M. Klein. Surface topologies and self interactions in reactive and nonreactive Richtmyer-Meshkov instability. *Scientific Reports*, 13:837, 2023.
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- [373] M. Klein, A. Sadiki, and J. Janicka. Effects of the surface stretching or the surface deformation rate on the breakup of a viscous drop in simple shear flow: Numerical simulation. In *5th International Symposium on Engineering Turbulence Modelling and Measurements*, Mallorca, September 2002.
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- [378] M. Klein, A. Sadiki, and J. Janicka. Study of primary jet breakup using direct numerical simulation. In *ILASS-Europe 2000, 16. Annual Conference on Liquid Atomization and Spray Systems*, Darmstadt, September 2000.

Invited Talks

- [379] M. Klein. Machine learning for (LES based) turbulence modelling. In *Division of Fluid Mechanics*, Lund University, Sweden, June 2023.
- [380] M. Klein. Towards gene expression programming for high fidelity LES closures. In *International Conference on Advanced Computational Engineering and Experimenting*, Florence, Italy, July 2022.
- [381] M. Klein. Part 1: Generation of synthetic turbulent inflow conditions; part 2: LES modelling using gene expression programming. In *Lecture: Innovative approaches to the simulation of turbulent flows in aerospace propulsion systems*, University of Turino, Italy, May 2022.
- [382] M. Klein. Recent efforts in LES modelling using traditional and machine learning techniques. In *Aerodynamics Seminar*, TU Delft, Netherlands, March 2022.
- [383] M. Klein. Towards LES of primary atomization. In *International Workshop on Clean Combustion: Principles and Applications*, Darmstadt, September 2019.
- [384] M. Klein. Towards LES of multiphase flows with moving interfaces. University of Groningen, July 2019.
- [385] M. Klein. Towards LES of multiphase flows with moving interfaces. Darmstadt, May 2019.
- [386] M. Klein. Towards LES of multiphase flows with moving interfaces. In *16th Multiphase Flow Conference and Short Course*, Dresden, November 2018.
- [387] M. Klein. Mathematische und physikalische Modellierung von turbulenten Zweiphasenströmungen. ITLR, University Stuttgart, March 2018.
- [388] M. Klein. Towards LES for two phase flows. Helmholtz-Zentrum Dresden-Rossendorf, July 2017.
- [389] M. Klein. Recent experiences with modelling of turbulence chemistry interaction in the context of LES using DNS of turbulent premixed generic planar flame configurations. Annual meeting of the UK Consortium on Turbulent Reacting Flows, September 2016.
- [390] M. Klein. Analysis of the combined modelling of subgrid transport and filtered flame propagation for premixed turbulent combustion. University of Duisburg, January 2015.
- [391] M. Klein. An attempt to assess the quality of les in the context of implicit filtering. University of Newcastle, November 2013.
- [392] M. Klein. Industrial CFD: Applications and challenges. Technical University of Munich, February 2013.
- [393] M. Klein. 3D CFD base engine development. University of Applied Science, Darmstadt, December 2010.
- [394] M. Klein. 3D CFD base engine development. University of Applied Science, Darmstadt, December 2009.
- [395] M. Klein. 3D CFD base engine development. University of Applied Science, Darmstadt, January 2008.
- [396] M. Klein. LES quality assessment. In *8th Workshop on Turbulent Nonpremixed Flames*, Heidelberg, August 2006.

- [397] M. Klein. Quality assessment of LES in the context of implicit filtering. In *Quality Assessment of Unsteady Methods for Turbulent Combustion Prediction and Validation*, Darmstadt, June 2005.
- [398] M. Klein. Numerical and experimental characterization of the turbulence structure in swirled flows. Cambridge University, November 2004.
- [399] M. Klein. How LES can be made an engineering tool. Cambridge University, July 2004.
- [400] M. Klein. Direkte numerische Simulation von ebenen ein- und zweiphasigen Freistrahlen. University of Zurich, Mai 2003.
- [401] M. Klein. On the artificial generation of inlet and initial data for unsteady turbulent flow simulation. In *17. TECFLAM-Seminar*, Stuttgart, Dezember 2003.

Patents

- [402] M. Klein und S. Kraft. Hydrostößel mit einer zweiten Ölzuführung. *DE102011101239*, 15.11.2012.
- [403] W. Schlidt, P. Seeger, S. Vogel, C. Tauscher, M. Klein, and R. Maucher. Zylinderkopf mit Flüssigkeitskühlung und Verfahren zur Kühlung des Zylinderkopfes. *DE102010052830*, 31.05.2012.
- [404] P. Seeger M. Klein, M. Janeck. Auslasssystem für einen Verbrennungsmotor. *DE102011116360*, 19.10.2011.