

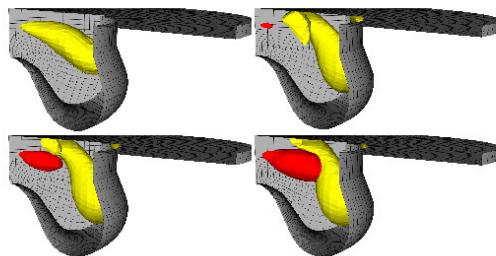


Christian Hasse (Autor)

A Two-Dimensional Flamelet Model for Multiple Injections in Diesel Engines

Christian Hasse

A Two-Dimensional Flamelet Model for Multiple Injections in Diesel Engines



Cuvillier Verlag Göttingen

<https://cuvillier.de/de/shop/publications/2820>

Copyright:

Cuvillier Verlag, Inhaberin Annette Jentzsch-Cuvillier, Nonnenstieg 8, 37075 Göttingen,
Germany

Telefon: +49 (0)551 54724-0, E-Mail: info@cuvillier.de, Website: <https://cuvillier.de>

Contents

1	Introduction	1
2	Laminar Flamelets	5
2.1	Flamelet Equations for a Single Mixture Fraction	7
2.1.1	Introduction of a Local Coordinate Transformation and Boundary Layer Arguments	8
2.1.2	Derivation Using a Two-Scale Asymptotic Analysis	10
2.1.3	Scalar Dissipation Rate	13
2.2	Flamelet Equations for two Mixture Fractions	16
2.2.1	Derivation Using a Three-Scale Asymptotic Analysis	16
2.2.2	Joint Scalar Dissipation Rate	18
2.2.3	Coordinate Transformation to a Unit Square	22
3	Description of the Turbulent Flow and Mixing Field	25
3.1	Governing equations	25
3.2	Scales of Turbulent Motion	26
3.3	Averaging	28
3.4	Turbulent Flow Field	28
3.5	Turbulent Mixing Field	32
3.5.1	Conserved Scalar	32

3.5.2	Nonconserved Scalar	33
3.6	CFD Code	38
3.6.1	Liquid Phase	39
4	RIF Model	41
4.1	RIF Model for a Single Mixture Fraction	41
4.1.1	Flamelet Parameters for a Single Mixture Fraction	42
4.1.2	Calculation of Turbulent Mean Mass Fractions and Temperature	43
4.1.3	Multiple Flamelets	44
4.2	RIF Model for Two Mixture Fractions	45
4.2.1	Flamelet Parameters for Two Mixture Fractions	47
4.2.2	Calculation of Turbulent Mean Mass Fractions and Temperature	47
4.3	Applicability of the different RIF Models and Modeling Strategy . . .	50
4.3.1	Initialization of a Two-Dimensional Flamelet	54
4.3.2	Simplified RIF Models	56
5	Chemical Mechanism and Modeling of Pollutant Emissions	57
5.1	Surrogate Fuel	57
5.1.1	Experiments	57
5.1.2	Chemical Mechanism for Simulations	59
5.2	Pollutants	60
5.2.1	Soot Model	60
5.2.2	NO _x Model	65
6	Experimental and Numerical Setup	69
6.1	Engine Experiments	70

6.2	Injection Rate Measurements	71
6.3	Numerical Setup	74
7	Results and Discussion	77
7.1	Reference Case, Operating Point C	77
7.1.1	Model Comparison	77
7.1.2	Physical Mechanism Leading to the Ignition of the Main Injection	79
7.1.3	Influence of the Scalar Dissipation Rate on the Propagation Speed	83
7.1.4	Merging of the Mixture Fields, Influence of Interaction Coefficient I	85
7.1.5	Variation of Injection Timing and Dwell Time, Pollutants	91
7.2	Operating Points A, B and C with 40% EGR	93
7.3	Approximation of the Flame Propagation Process	96
8	Summary and Conclusions	101
9	Bibliography	103
A	Pressure curves	115
A.1	Operating Point A	116
A.2	Operating Point B	118
A.3	Operating Point C	120
A.4	Operating Point C with 40% EGR	122