

Table of Contents

Table of Contents i

Abstract/Zusammenfassung iii

Nomenclature v

1 Introduction 1

2 Test Engines 7

2.1 TINA 7

2.2 SUZI 15

3 Methods and Experimental Setup 17

3.1 Theory of PIV 17

3.1.1 Tracer Particles 18

3.1.2 Stereoscopic Particle-Image Velocimetry 21

3.2 Experimental Setup 24

3.2.1 General Features 24

3.2.2 Monoscopic PIV Setup 28

3.2.3 Stereoscopic PIV Setup 29

3.3 PIV Post-Processing 31

3.3.1 Image Enhancement 31

3.3.2 PIV Algorithm 33

3.3.3 Derived Flow Quantities 36

4	Results and Discussion	45
4.1	Time-Averaged Flow Topology	45
4.1.1	Symmetry Plane	45
4.1.2	Cross-Tumble Plane	50
4.2	Comparison of the In-Cylinder Flow of Two Engines	58
4.2.1	Symmetry Plane	58
4.2.2	Temporal Analysis	62
4.2.3	Quasi 3D Results	68
4.3	Impact of a Non-Uniform Density Distribution	71
4.3.1	Symmetry Plane	71
4.3.2	Cross-Tumble Plane	78
4.3.3	Temporal Analysis	85
4.4	Analysis of Cyclic Variations	87
4.4.1	Path of the Tumble Vortex Core	87
4.4.2	Kinetic Energies	94
4.4.3	Proper Orthogonal Decomposition	97
5	Summary and Conclusions	103
6	References	107
7	Author-related pre-published papers and theses	115