

Contents

Acknowledgements	iii
Abstract	v
Contents	ix
1 Introduction	1
1.1 Definition of turbulence	1
1.2 Historical perspective	4
1.3 Wall-bounded turbulence	15
1.4 Relevance of coherent structures	18
1.5 Objectives	21
1.6 Outline of the thesis	22
2 Couette and Poiseuille channel flows	25
2.1 Simulation domain	26
2.2 One-point statistics	28
2.3 Coherent structures	35
3 Methods	41
3.1 DNS numerical method	42
3.2 Post-processing techniques for data analysis	47
4 Results and Conclusions	63
4.1 Conditions and dimensions of large-scale coherent structures	63

4.2	Large-scale coherent structures in thermal Couette flows and their influence on the 1-point statistics	66
4.3	Impact of stratification on large-scale coherent structures	67
4.4	Influence of shear ratio on structure dynamics	68
4.5	Future research directions	70
5	Summary of Papers	73
	Bibliography	77
	Paper 1. The link between the Reynolds shear stress and the large structures of turbulent Couette-Poiseuille flow	87
	Paper 2. Evidences of persisting thermal structures in Couette flows	95
	Paper 3. Stratification effect on the extreme-scale rolls in the plane Couette flows	112
	Paper 4. Sequential and parallel algorithms to compute turbulent coherent structures	126
	Paper 5. Spatial and energetic organization of coherent structures in Couette-Poiseuille turbulent channels	142