
Contents

ACKNOWLEDGMENTS	ix
INTRODUCTION	xi
CHAPTER 1. DRIVING SIMULATION	1
1.1. Objectives of driving simulation	1
1.2. A short history of driving simulators	3
1.2.1. Fixed-base platforms	3
1.2.2. Platforms with a serial structure	5
1.2.3. Platforms with parallel structure	5
1.2.4. Hybrid structured platforms	10
1.2.5. “Low-cost” generation	14
1.3. Driving simulation objectives	16
CHAPTER 2. ARCHITECTURE OF DRIVING SIMULATORS	19
2.1. Architecture of driving simulators	19
2.2. Motion cueing and haptic feedback	26
2.2.1. The human motion perception system	27
2.2.2. Mathematical description	30
2.2.3. Motion cueing algorithm	33

2.3. The evolution of simulators: from the automobile to the motorcycle	48
2.3.1. Honda simulators	48
2.3.2. Tokyo university simulator	51
2.3.3. MORIS simulator	52
2.3.4. SafeBike simulator	53
2.3.5. Bicycle simulator – Kaist	55
2.3.6. Discussion	55
CHAPTER 3. DYNAMICS OF TWO-WHEELED VEHICLES .	57
3.1. Modeling aspect	57
3.1.1. Vehicle motion	59
3.1.2. Road–tire interface	60
3.1.3. Direction system	65
3.1.4. Suspensions	67
3.1.5. Motorization and traction chain	67
3.2. The literature on existing models	69
3.2.1. Models of the automobile	69
3.2.2. Two-wheeled vehicle models	71
3.3. Dynamic behavior of automobiles	77
3.4. Dynamic behavior of two-wheeled vehicles	77
3.5. Summary	82
CHAPTER 4. TWO-WHEELED RIDING SIMULATOR: FROM DESIGN TO CONTROL	85
4.1. Introduction	85
4.2. The design and mechanical aspects of the simulator . .	86
4.3. The mechatronics of the simulator	92
4.3.1. Description of the simulation loop	92
4.3.2. Platform instrumentation	94
4.3.3. Sequencing and synchronization	99
4.4. Specification of the simulator	101
4.4.1. Inverse kinematic of the simulator platform	101
4.4.2. Dynamic modeling of the platform	107
4.4.3. Identification	109

4.5. Multi-sensory integration: washout and force feedback	116
4.5.1. Localization of the washout	116
BIBLIOGRAPHY	125
INDEX	135