Summary
This thesis focuses on two main aspects regarding online adjustments in goal-directed movements: one is the generality of online adjustments, the other is the effects of ageing on this fast process. Not only the results of performance are reported, but also the process of how people adjust to the perturbations. Several types of perturbations and tasks have been used in this thesis to check the generality of the online adjustments, with special interest given to response latency of these adjustments.

In Chapter 2, online adjustments were investigated in reaching movements among young adults. Target jump and background motion were applied and responses induced by the two types of perturbation were compared. Participants needed to tap on a target as accurately and quickly as possible, but a sudden perturbation could occur in some random trials. The hand responses were fast to both perturbation types (110-125 ms). Surprisingly, there was no direct coupling of hand and head, because the head only responded to background motion not target jumps. This suggested a need to keep the head relatively stable to the surrounding, and this could be due to inferred self-motion. This explanation is examined in Chapter 4. Another finding of this study is that the upper-trunk response was even faster (below 100 ms) than the hand, suggesting anticipatory postural adjustments in reaching with visual perturbations.

In Chapter 3, same task as Chapter 2 was performed in the older adults to examine ageing’s effects on manual and postural adjustments (of other body parts that did not directly bring the hand to the target). The older adults could reach the target as accurately as the young, but spent more time to do so and adjusted about 15 ms later for the hand and about 20 ms for the wrist. They also responded less to target jumps, but more strongly to background motion. This reflects their reliance on the visual surrounding to adjust goal-directed movements.

To understand the origin of manual following response to background motion, vestibular perturbation (GVS) was introduced in the study (Chapter 4). Head responses were considered as evidence of having inferred self-motion, induced by
background motion or GVS; the controlled trials with target jumps did not induce head responses (as Chapter 2). As a result, the compensation theory is unlikely to be true that the manual following response is a whole-body compensation of self-motion, as the hand response had an order of magnitude too strong compared to that caused by GVS.

Chapter 5 set out the goal-directed movements in continuous walking on a treadmill, where young participants were instructed to step on projected targets as accurately as possible. A double-step paradigm (target jump) was again applied during early-swing in random steps, and in the medio-lateral direction. A small target shift of 2.5 cm successfully induced about 80% correction (in distance) with a latency about 155 ms of the foot behaviour, and 123 ms of the gluteus medius activity. It is concluded that the goal-directed movements of the lower limb were also fast.

In Chapter 6, same task as Chapter 5 was performed in the older adults to examine ageing’s effects in lower-limb online adjustments. When the movement time could not be extended on the treadmill, older adults had lower correction level. A prolongation of 20 ms was also observed at the behavioural level (foot kinematics), but not much in muscle activity (10 ms longer for lateral adjustments, no delay for medial adjustments). Surprisingly, the medial responses were similar in the two age groups, which might be due to the difficulty to narrow down balance margin in general for all people.

The last chapter linked all findings from different studies together. To conclude the first aspect of the thesis, the online control processes appeared in all those studies might be similar, and the pathways used in online control depend on the complexity of the sensory feedback and the level to process information. To briefly conclude the second aspect, ageing affects online adjustments during goal-directed movements, mainly due to deteriorated muscle functions, which makes future research promising in improving the ability to make online adjustments for the older adults.