lec01072010 – proprioception and the vestibular system

the weekly principle(s): ‘the neuron doctrine’ and ‘law of dynamic polarization’
sensory organ receptors: across different sensory modalities, anatomical features of sensory organ receptors determine the dynamics of their electrical activity and, within a modality, the type of sensory information they convey.
proprioception and touch sense: the ‘all-axon’ ganglion cell
a simple proprioceptive circuit / system – the knee-jerk reflex
the muscle spindle: activation by muscle elongation / stretch is modulated by contraction state of the muscle
the Golgi tendon organ: registering tendon stretch (= muscle contraction)
functions of proprioception:

- joint-protecting reflexes (e.g., knee-jerk)
- adjustment of muscle contraction / recruitment
- kinesthesia: detection of body position and movement
- coordination of motor commands
- sense of self?
dorsal root ganglion pathways to the brain
somatosensory cortex: integration of proprioceptive and tactile information
the Pinnochio effect
functions of the vestibular system:

- postural reflexes
- gaze adjustment
- assessment of self motion
- a reason not to drink too heavily?
the ‘hair cell’ receptor – transduction of both head motion (vestibular system) and sound waves (auditory system) into neural signals
the ‘hair cell’ receptor – transduction of both head motion and sound
the inner ear
orthogonal orientation of the semicircular canals and otolith organs
semicircular canals: hair cell registration of rotational velocity, orthogonality, and the L/R push-pull system
registration of linear translation and static head position via the otolith organs, the utricle and saccule

registration of rotational velocity of the head (about the trunk) via the semicircular canals
utricle and saccule: registration of static head position (relative to ground / gravity), orthogonality, and the hair cell population code
vestibular afferents: pathway to the brain and spinal cord
integrating vestibular signals I – the vestibulo-ocular reflex – adjusting and maintaining gaze during head movements
integrating vestibular signals II – the ubiquitous ‘head-direction’ neuron