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Human Physiology
MidTerm - 2

1) Haptics - the sense of touch - enables humans to perform a vide variety of exploration and manipulation of tasks in the real world - In virtual words & robot -teleoperations scenarios, this sense of touch must be artificially recreated by stimulating the human body (typically the hands) in a manner that produces the salient features of touch needed to enhance realism & human performance.

2) The sense of touch is typically described as being divided as being into two modalities : kinesthetic and tactile.
- Kinesthactic sensations such as forces and torques are sensed in the muscles, tendons and joints
- Tactile sensations such as pressure, shear and vibrations are sensed by specialised sensory end organs known as mechanoreceptors that are embedded in the skin
- Each type of mechanoreceptor senses & responds to a specific type of haptic stimulus.
- The mechanoreceptors are fast-adapting mechanoreceptors capture transient signals & slow adapting mechanoreceptors capture mostly static stimuli -
- Mechanoreceptors especially pacinian corpuscles, merkel cells meissners corpuscles, ruffini endings have specialised functions.

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3)- Variable - Friction surfaces is the best as these displays change the fraction between a human finger and a plate by vibrating the plate at high (ultrasonic) frequencies.
- Another way to modulate friction uses changing electrostatic forces. The effect is not typically as strong, but electrostatics has advantage that it uses no moving parts.

4)
- Standard haptic actuators are built with embedded electrical motors. An electrical signal is sent to the motor telling it to vibrate at a specific rate. The rate is adjustable and can be configured for a variety of patterns.
- In order to control the motor, a logical circuit component is needed. Power is also needed To drive the motor.

5)
- Haptic Retargeting combines the concepts of encountered-type haptic devices and pseudohaptics. de
- Moving the visual representation of the hand in the virtual environment is flat, can imply curvature.
- This same effect is used to display angular information.
- Taking advantage of visual dominance in proprioception enables the use of visual stimuli to exaggerate the angular displacement of the head which can be used for redirected walking.

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6)

— A astraunaut tekoperating a robot outside the International Space station to enable repair tasks while avoiding dangerous human space walk.

— A surgeon using a robot to perform a delicate procedure at a scale not achievable with the human hand.

— In some cases, we seek to replace a sense of touch that was lost owing to disease or accident. An upper-limb amputee has completely lost the sense of touch, a prosthetic hand would sense haptic interactions between itself and the environment & relay that information back to amputee.

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Q8

1) How will we identify and understand the perceptual basis of new haptic illusions to facilitate the design of haptic systems with minimal sensing & actuation? Two key challenges will be identifying haptic illusions that are robust across users & determining the ideal actuation parameters for creating the strongest illusion.

2) Can we enable consumer haptic devices by decreasing cost, size of and weight & power requirements, potentially via the use of novel actuators & smart materials? The challenges here will be reducing the size of haptic actuators while maintaining bandwidth, force output, range of motion and important degrees of freedom, powering haptic actuators with mobile & enabling wireless communication with control of haptic devices.

3) Is it possible to create predictive models of human perception and cognition surrounding touch feedback, in order to decrease reliance on exhaustive human user studies? Past psychophysics studies have focused on human touch, ~~in order to decrease reliance on exhaustive human user~~ perception at a small number of locations on the body including the hand so it will be useful our knowledge of touch perception to cover other body locations.