PERCEPTION AND ACTION

Visual Perception

Ecological Approach to Perception

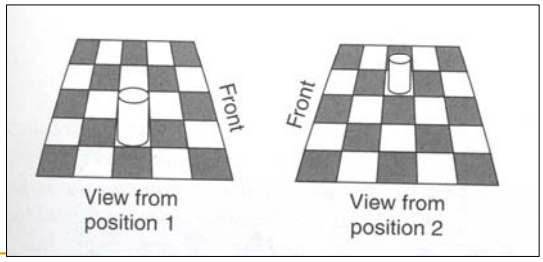
- J. J. Gibson in 1929
- Traditional experiments too constrained
  - Subjects cannot move their heads
  - Study of snapshot vision
- Perception in its natural environment
- Emphasizes relationship between perception and movement
- What is available in environment for perception?

Beginnings

- During World War II
- Pilots ability to land successfully
  - No binocular disparity at that distance
  - No apparent size
  - Characteristics of ground
  - Information provided by the plane's movement

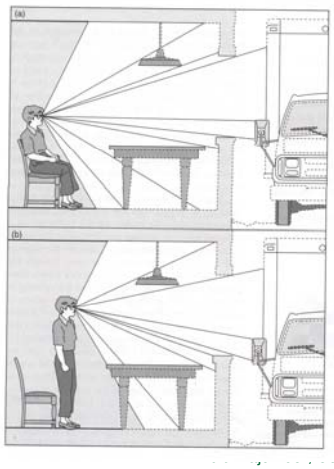
Information on Retina vs. Environment

- Information from retina
  - Size constancy via depth
- Information from Environment
  - Size constancy via size of the squares in the checkerboard



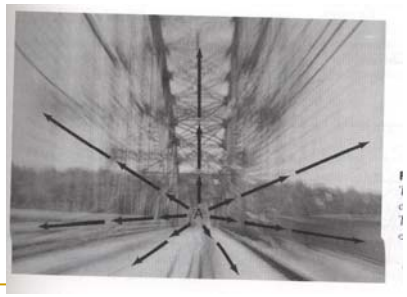
Ambient Optic Array

- Ecological optics
  - Description of stimulus based on ambient optic array
- Ambient Optic Array
  - Structure of the stimulation available at any point in the environment
- Optic Flow
  - Continuous change in Ambient Optic Array
  - Due to movement



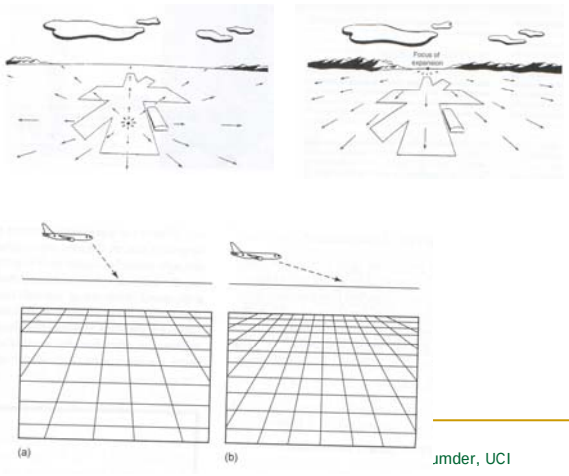
Optic Flow

- Effect of movement on optic array
  - Gradient of flow
  - Speed of Flow
  - Focus of expansion
    - Tells where the person is heading to



Cues Used

- Focus of expansion
  - Location
- Texture gradient
  - Angle



Uniqueness

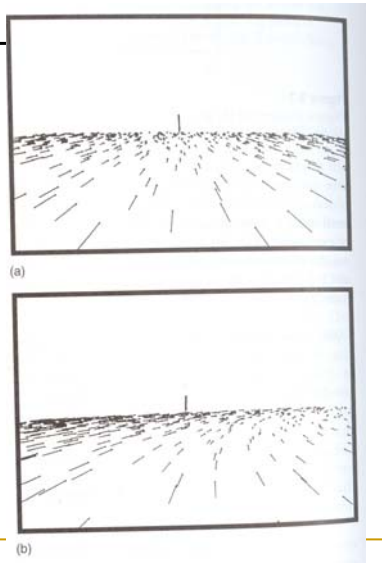
- Optical flow is self produced
  - Cycle, observer moves, produces flow, makes observer change movement based on feedback, creates different flow
- Though it moves, it provides information that is invariant or constant
  - Like focus of expansion

Visual Control of Action

- Optic Flow help us
  - Reach destination
  - Maintain balance
  - Anticipating collision
- Take appropriate actions

Judging Destination

- Just from optical flow

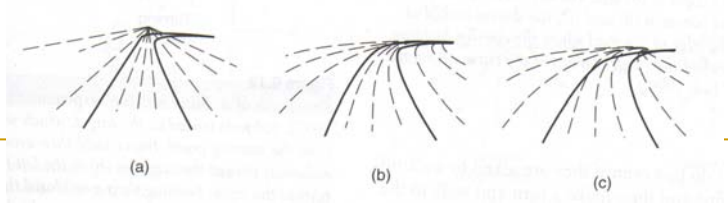


Reaching Destination

- Is optic flow sufficient?
  - Yes
- Do people use flow information?
  - Partially
  - Partially other cues

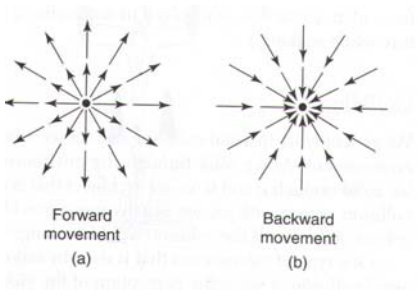
Reaching Destination

- Optical flow lines coincide with road
  - If drivers executing a curved correctly
- Visual direction strategy
- Other cues
  - In dark or snow storm
  - Blind walking experiments



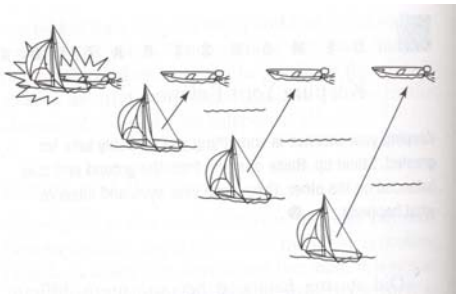
Posture or Balance

- Visual stimulus is critical for balance
  - Standing on one leg experiment
- Maintaining posture
  - Swinging room expriment
  - Children fell
  - Adults acted like puppets
  - Ripley's Believe It or Not



Anticipating Collision

- Direction of View : Bearing
- Estimating object's distance and speed
- Tau strategy
  - Size of object in different pictures
  - Rate of expansion of object's edges
- Visual cues for gymnasts



Neural Mechanisms

- Collision sensitive neurons in pigeons
- Neurons in medial superior temporal (MST)
  - One kind fires with expanding stimulus
  - Other fires with circular movement

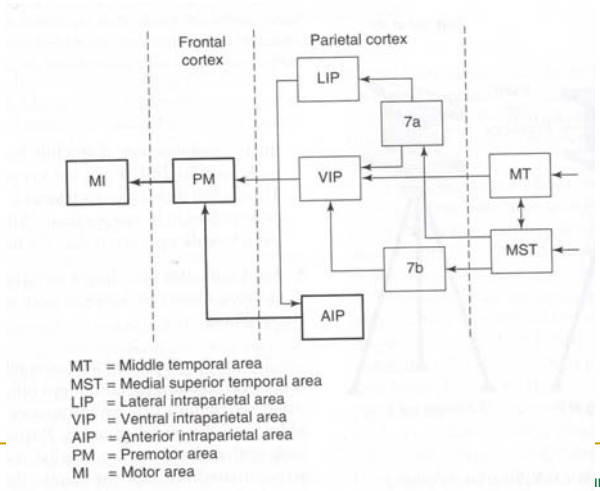
Does flow information affect neurons?

- MST responds to large receptive fields
- Perception flow summates over a large area of the visual field
  - Spatial summation experiment

Slant based on Potential for Action

- Subjects asked to estimate the slant of a hill
  - Verbal
  - Visual
  - Haptic
- Verbal and visual
  - Overestimated
    - Depends on the hardness of the task of climbing it
    - Depends on the physical condition of the subject
- Haptic
  - Correct estimation
  - Helps to do job with maximum efficiency

Perception meets the Motor System



Important Parts

- Anterior inter-parietal area (AIP)
- Pre-motor area (PM)
- Motor area (MI)

Anterior Inter-parietal Area (AIP)

- Motor dominant neurons
  - Responds to action only
- Visual dominant neurons
  - Responds to vision only
- Visual and motor neurons
  - Responds to both
- Located between the vision and the motor area

Pre-motor Area (PM)

- Mirror Neurons
  - Monkey grasps an object
  - Looks at another person grasping an object
  - Not to a pair of pliers grasping an object
- What are these for?
  - Understand motor actions and react to them
  - Mimic actions

Mirror Neurons in Humans

- Responds to observation, action and imitation
- Maximum during imitation

Action, Hearing and Vision

- Sound cues are very important
  - Gymnasts
- McGurk Effect
  - Different perception based on
    - Only speech
    - Both vision and speech