Two-Dimensional (2D) Video Data Collection and Analysis

Principles of Photogrammetry
2D Video Data Collection

- Principles of Photogrammetry
  - Field of View
    - Rectangular area seen by the recording medium after passing through the camera's optics
    - The entire movement should be
      - small enough to fit within the camera's field of view yet be
      - as large as possible to improve the quality of the analysis
    - Avoid recording motion at the edges of the field of view
      - The greatest amount of image distortion occurs here
2D Video Data Collection

- Principles of Photogrammetry (continued)
  - Focus
    - Focus is *how clearly* an object can be seen
  - Exposure Time
    - “duration of time that the recording medium is exposed to light passing through the camera's lens”
    - It is a function of
      - Camera speed *(frame rate)*
      - Shutter speed
2D Video Data Collection

• Principles of Photogrammetry (continued)
  • Camera speed (frame rate)
    • How fast the camera records images
      • 30 frames per second (fps) in NTSC format
      • specially designed video cameras can record at rates of 60, 120, and 240 fps, and
      • expensive optical systems can reach 2000 fps
    • Faster camera speeds (frame rates) mean
      • More data are recorded (greater amounts of information)
      • Less blur of the movement body part or object
      • But, shorter exposure times mean reduced visibility of markers
2D Video Data Collection

- Principles of Photogrammetry (continued)
  - Shutter speed
    - How long the shutter (i.e., the eyelid of the camera) is open for each frame
      - Slow shutter speeds (e.g., 1/60 s)
        - make a fast-moving marker look like a blur across the screen instead of a single spot
      - Fast shutter speeds (e.g., 1/2000 s)
        - freeze action, but brief exposure times may reduce visibility of markers
2D Video Data Collection

- Principles of Photogrammetry (continued)
  - Exposure Time Recommendations
    - Greater camera speeds provide more information about the movement and less blur of the body part or object
    - Faster shutter speeds prevent blurring and make measuring the coordinates of the marker more reliable
    - Recording indoors generally requires supplemental lighting to use this fast shutter speed
      - A portable light source mounted near the video camera will increase the light hitting the performer and will help to ensure good visibility during the measuring process
2D Video Data Collection

- Principles of Photogrammetry (continued)
  - Camera Tilt
    - When a camera’s optical axis is not perpendicular to the plane of motion, distances are distorted (perspective error)
    - To minimize this effect use a telephoto lens and zoom in on the subject
      - This technique flattens the subject and reduces perspective error
2D Video Data Collection

- Principles of Photogrammetry (continued)
  - Calibration of Imagining Systems
    - A calibration system is used to ensure that the image coordinates are correctly scaled to real-world size
    - For 2-D systems with one camera,
      - Use a object with known size placed in the subject's plane of motion
      - The plane of the object must be parallel to the plane of motion
2D Video Data Collection

- Principles of Photogrammetry (continued)
  - Calibration of Imagining Systems
    - By measuring a known distance, a scaling factor is determined
      
      \[ s = \frac{\text{actual length (meters)}}{\text{digitized length (arbitrary units)}} \]

- Any measured distance can now be converted to real-world distances.