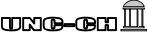


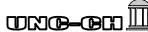
# THE BIOMECHANICS OF DISCUS THROWING

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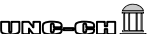
## Discus Throw

- Most beautiful human movements in track and field
- Most technical demanding throwing event in track and field
  - High speed
  - Limited space
  - Three-dimensional movements
  - Aerodynamic effect on official distance



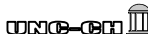
## Discus Throw

- Many debates about the techniques in coaching literature
- Limited biomechanical studies
- More things we don't know than things we know

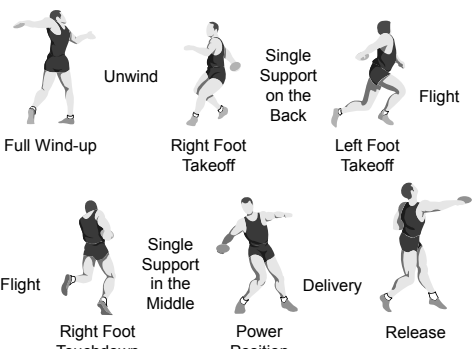


## USATF Discus Throw Database

- 3-D biomechanical data of over 300 trials from
  - 1990 Goodwill Games
  - 1990 Olympic Festivals
  - 2001 New Zealand Open
  - 1996 to 2006 USATF Outdoor National Championships and Olympic Team Trials




## Discus Throwing Technique

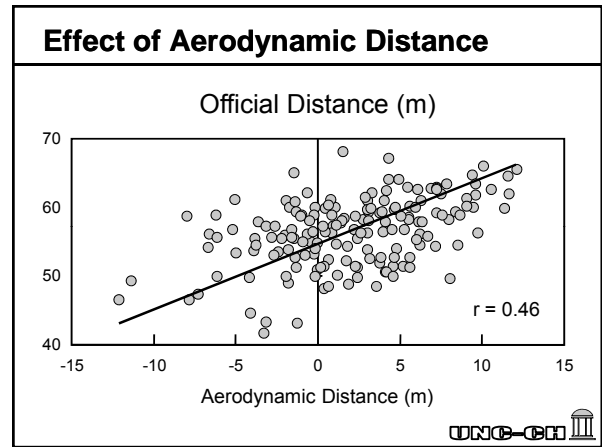
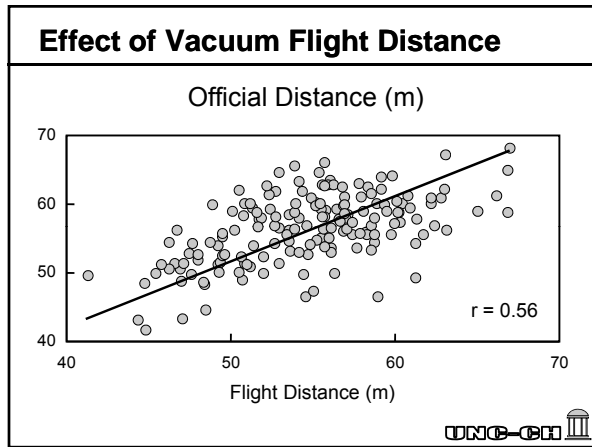
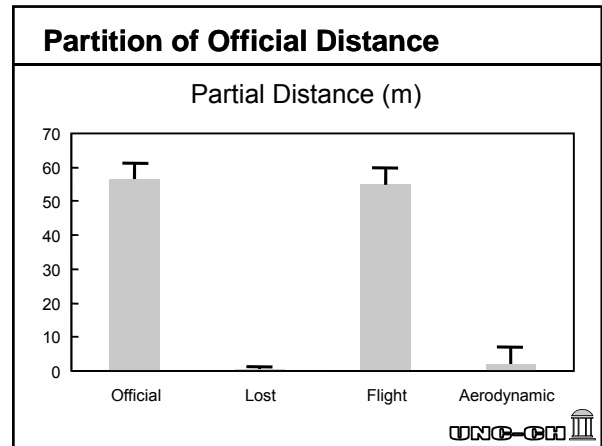
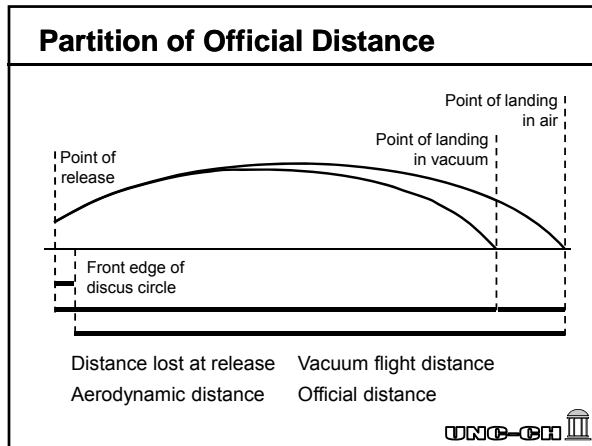


UNC-CH logo

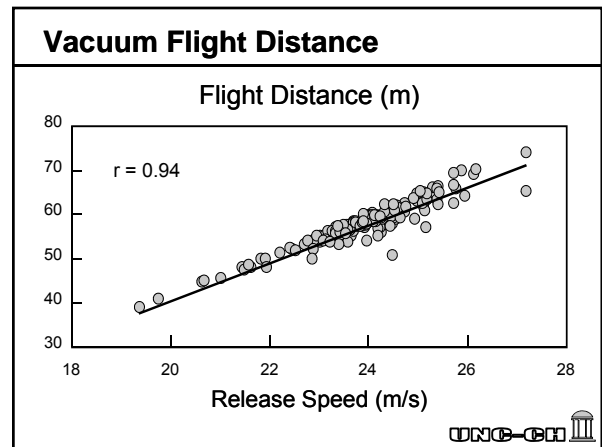
## Official Distance of Discus Throw

- Official distance of discus throw
  - Distance lost at the release
  - Vacuum flight distance
  - Aerodynamic distance



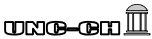


- ### Vacuum Flight Distance
- Major component of the official distance
  - Mainly determined by release speed
  - A reflection of throwing ability

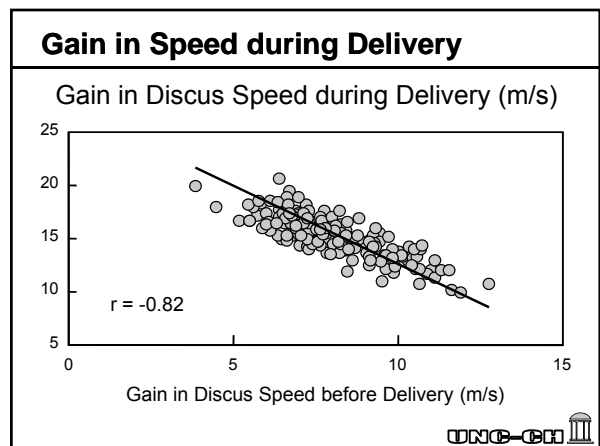
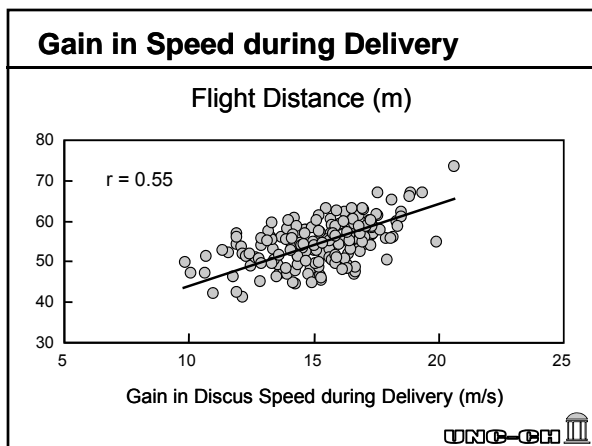
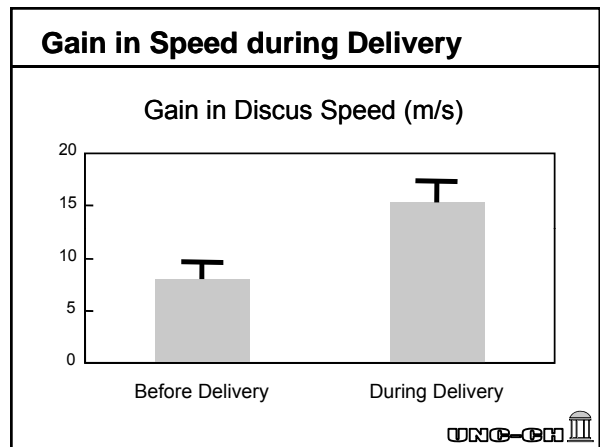
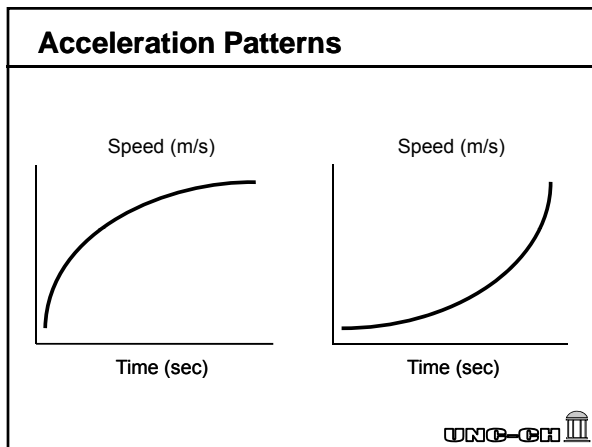


### How to Maximize Release Speed

- Appropriate temporal rhythm
- Large hip-shoulder separations
- Large shoulder-arm separations
- Powerful left leg block with full hip and knee extensions
- Appropriate ground contact

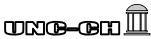


## Temporal Rhythm



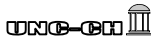
**Temporal Rhythm**

- Slow Unwind
- Start acceleration from flight (accelerate lower body rotation, not the discus)
- Quick left foot landing to form the power position
- Full acceleration during the delivery



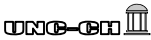
**Optimum Temporal Rhythm**

- Unwind  $\geq 0.6$  sec
- $0.45 \text{ sec} \leq$  Single support on the back  $\leq 0.55$  sec
- $0.08 \text{ sec} \leq$  Flight  $\leq 0.12$  sec
- $0.17 \text{ sec} \leq$  Single support in the middle  $\leq 0.22$  sec
- $0.15 \leq$  Delivery  $\leq 0.17$  sec



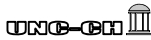
**Temporal Rhythm**

- Consequences of quick unwind
  - Difficult to control upper body movements after flight
  - Poor hip-shoulder and shoulder-arm separations after the flight
  - Difficult to gain speed during delivery



**Temporal Rhythm**

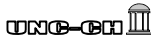
- Duration of flight is not the shorter the better
- Optimum duration of flight
  - Increase hip-shoulder and shoulder-arm separations
  - Get appropriate body position to start the single support in the middle to minimize the loss in momentum before the power position

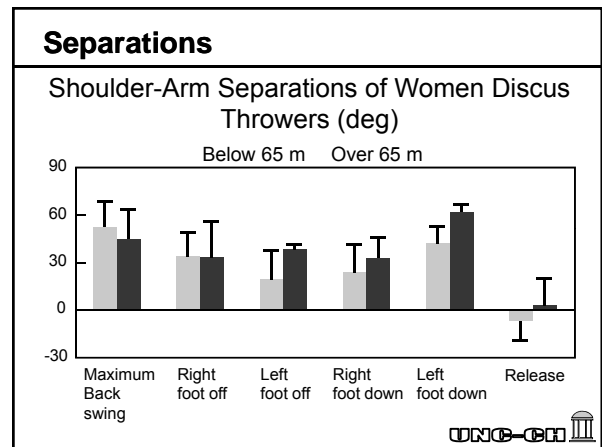
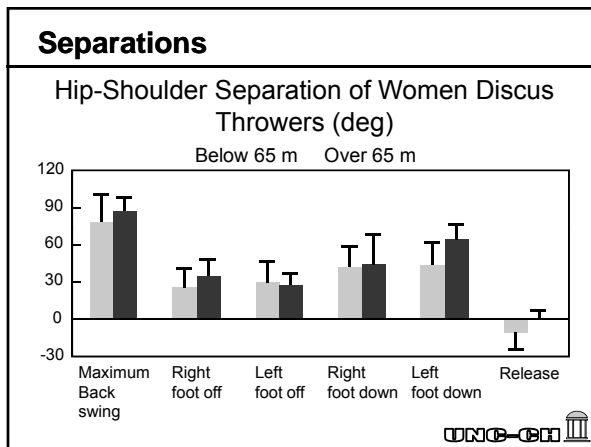
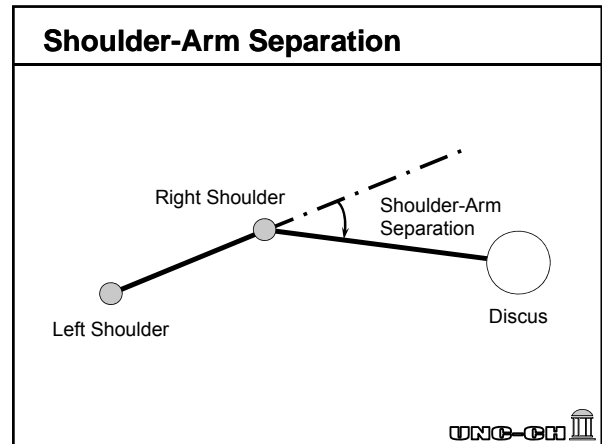
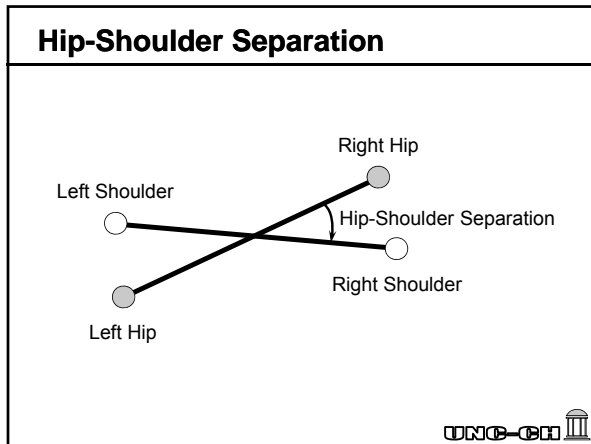


**Separations**

**Separations**

- 2/3 of the discus speed at release are obtained during the delivery
- Large hip-shoulder and shoulder-arm separations at the power position are critical for gaining discus speed during delivery
- Good separations before the flight are helpful for large separations at the power position



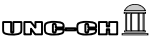


- ### Have Large Separations
- Have large separations at right foot down
    - Control of speed and upper body movement before left foot off
    - Good separations at the left foot off
    - Twist the trunk during the flight

- ### Have Large Separations
- Increase separations during single support in the middle
    - Control speed before left foot off
    - Quick and continue right leg rotation after right foot down
    - Quick left foot down

**Twisting Trunk during Flight**

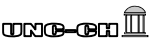
- The importance of twisting the trunk during the flight
  - Create hip-shoulder and shoulder-arm separations
  - Appropriate foot position for power position



**Right Leg Rotation and Left Leg Block**

**Leg Actions after Flight**

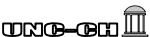
- Right leg rotation
  - Increase separations
  - Provide forward drive
  - Not right leg upward push
- Left leg block
  - Provide lift
  - Assist to forward drive from right



**Ground Contact during Delivery**

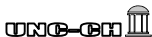
**Ground Contact during Delivery**

- Theoretically, retaining contact with the ground provides continuous forward drive and vertical lift
- Some of elite throwers have both feet off the ground at release



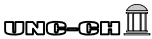
**Ground Contact during Delivery**

- Retaining ground contact at the release
  - Left knee and hip were not fully extended
  - Incomplete left block
- Losing ground contact too early
  - Early loss in forward drive and vertical lift



### Suggested Ground Contact Pattern

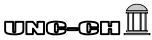
- Keep ground contact as long as possible especially the right foot until the release of the discus
- The left foot may be off the ground in the last portion of the delivery
- Jump up for reverse after the release



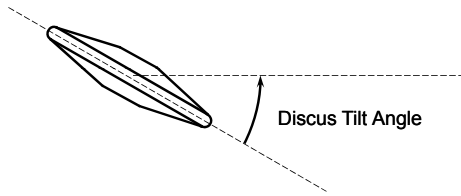
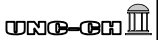
### Aerodynamic Distance

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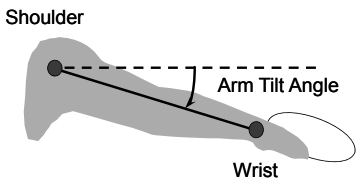
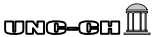
- An important factor affecting official distance
  - Range: 12 m (gain) to -12 m (lose)
  - $74.99 \text{ m} - 8.14 \text{ m} = 66.85 \text{ m}$
  - $64.14 \text{ m} + 3.82 \text{ m} = 67.96 \text{ m}$



### Discus Tilt Angle

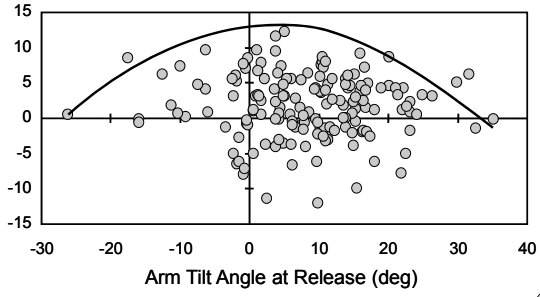
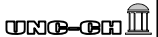



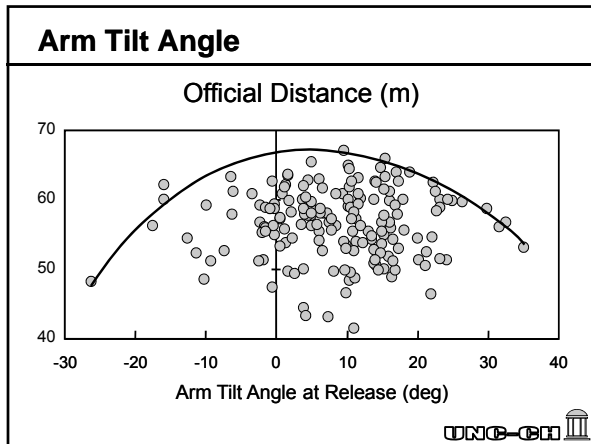
### Arm Tilt Angle

### Arm Tilt Angle

Aerodynamic Distance (m)



### Arm Tilt Angle

- Recommended arm tilt angle at release between 0 and 10 degrees

### Good Discus Throw Technique

### Good Discus Throw Technique

- Relaxed back swing
- Controlled unwind
- Wide right leg swing
- Vigorous forward drive
- Quick rotation of the hip and shoulder during the flight

### Good Discus Throw Technique

- High discus position at right foot landing
- Continue right leg rotation
- Quick left foot landing to form the power position
- Powerful right rotation and left block
- Controlled release with discus at shoulder level

### Good Discus Throwing Technique

- Irina Yatcheko
- Nationality: Belarus
- Birthday: 1965/10/31
- Height: 1.84 m
- Weight: 98 kg

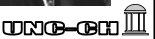

**Good Discus Throwing Technique**

- Performance:
  - 2000 Olympic Game Bronze Medal (65.20 m)
  - 2003 World Championship Gold Medal (67.32 m)
  - 2004 Olympic Game Bronze Medal (66.17 m)



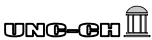

**Good Discus Throwing Technique**

- Andy Bloom
- Nationality: USA
- Birthday: 1973/8/11
- Height: 1.80 m
- Weight: 120 kg



**Good Discus Throwing Technique**

- Performance
  - 1997 USATF National Championships Third Place (65.30 m)
  - 1998 USATF National Championships Second Place (66.42 m)
  - 1999 USATF National Championships Third Place (67.46 m)



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