Sports Performance Visualisation in Teaching Activities

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Sports Performance Visualisation in Teaching Activities

[IntRoduction]   [Motivation]   [PHYSICAL BACKGROUND]   [Examples]   [Conclusion]

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[**IntRoduction**] [Motivation] [PHYSICAL BACKGROUND] [Examples] [Conclusion]

- Sport and Biomechanics
- Biomechanics - From an Eexercise in the Filming of Human Movement to Applied Science

Sports Performance Visualisation in Teaching Activities

- Interest in Sport
- Multidisciplinaritiy
- Application of Computer and Information Technologies
- Interactivity Problem in Teaching/Learning Process

- Result: Programms Simulating Sport Activities

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Sports Performance Visualisation in Teaching Activities

- About the Examples
- What We Need
- Basket-Ball
- Ski-Jumping
- Projectil

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- Sport Activities
- Physical Background
- Java Technology
- Programs:
  - Beyond the Traditional Learning Methods
  - Interactivity with Learning Environment
  - Visualisation
- Future Plans

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- **Ski-Jumping Example**
- Input Variables
- Forces Exerted on the Ski-Jumper
- Components of the Resultant Force
- Output Variables

- Ski-jumping is a very complex skill involving several phases such as:
  - inrun,
  - take-off,
  - flight,
  - landing.
- During the inrun and take-off phases ski-jumper trys to reach maximum velocity.
- In the flight phase ski-jumper trays to keep favorable body position angle.

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- Ski-Jumping Example
- **Input Variables**
  - Jumper's Position Angle
  - Approach Velocity
  - Take-Off Velocity
- Forces Exerted on the Ski-Jumper
- Components of the Resultant Force
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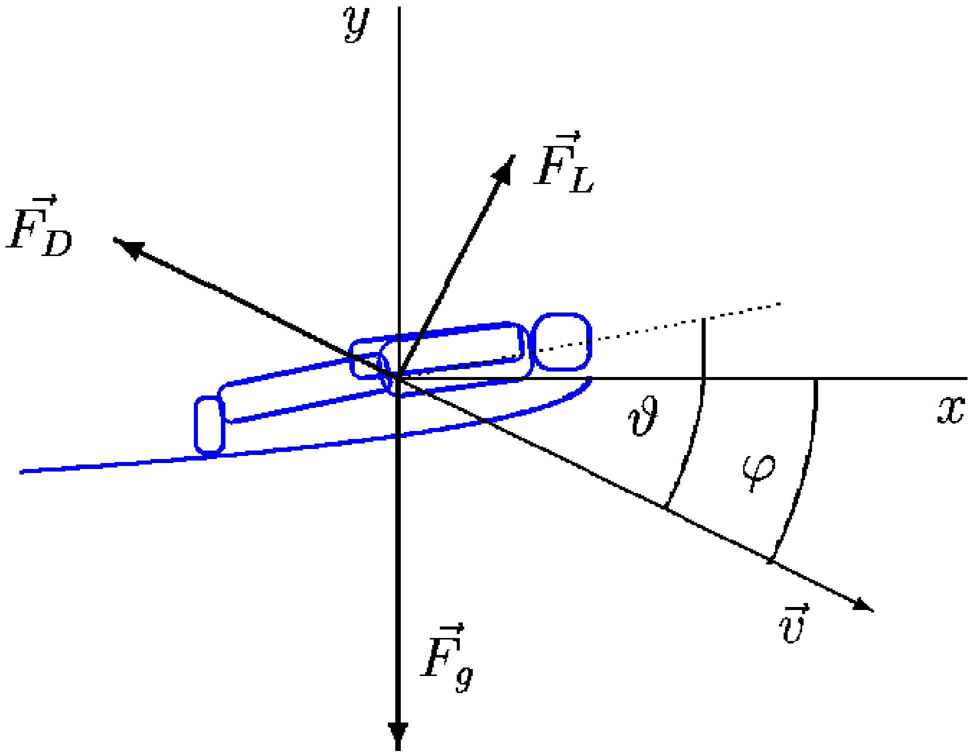
- Ski-Jumping Example
- Input Variables
- **Forces Exerted on the Ski-Jumper**
- Components of the Resultant Force
- Output Variables



The gravitational force: F_g

Dynamic fluid force:

- The drag force F_D acts in opposition to the relative motion of the jumper with the respect to air tending to slow down the relative velocity.
- The lift force F_L change the direction of the relative motion of the jumper within air.

Ski-jumper's position angle: ϑ

Flight path's angle: φ

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The horizontal component Fx:

$$F_x = \frac{1}{2} C_L \rho v^2 A_{||} \sin^2(\vartheta) \cos(\vartheta) \sin(\varphi) - \frac{1}{2} C_D \rho v^2 [A_\perp + A_{||} \sin^2(\vartheta) \sin(\vartheta)] \cos(\varphi)$$

The vertical component Fy:

$$F_y = -mg + \frac{1}{2} C_L \rho v^2 A_{||} \sin^2(\vartheta) \cos(\vartheta) \cos(\varphi) + \frac{1}{2} C_D \rho v^2 [A_\perp + A_{||} \sin^2(\vartheta) \sin(\vartheta)] \sin(\varphi)$$

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- Ski-Jumping Example
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Using Newton's laws of motion, inrun and take-off velocities, the instantaneous jumper's velocity and position are being calculated:

$$\frac{dv_x}{dt} = \frac{F_x}{m} \qquad \frac{dv_y}{dt} = \frac{F_y}{m}$$

$$\frac{dx}{dt} = v_x \qquad \frac{dy}{dt} = v_y$$

In calculation fixed time step integration of 0.01 s is being used.

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The gravitational force:

$$F_g = mg$$

The drag force:

$$F_D = \frac{1}{2} C_D \rho v^2 [A_\perp + A_{||} \sin^2(\vartheta) \sin(\vartheta)]$$

The lift force:

$$F_L = \frac{1}{2} C_L \rho v^2 A_{||} \sin^2(\vartheta) \cos(\vartheta)$$

m = 65 kg ski-jumper's mass
g = 9.8 ms^{-2} gravitational acceleration
ρ = 1.0 kgm^{-3} air density
C_D = 1 drag coefficient
C_L = 1 lift coefficient
$A_\perp$ = 0.2 m^2 frontal ski-jumper's surface
$A_{||}$ = 1.0 m^2 longitudinal ski-jumper's surface

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- **About the Examples**
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- They are Java Swing applets which run in a Java-enabled Web browser such as Microsoft Internet Explorer, HotJava, or Netscape Navigator.
- Swing components are used to build graphical user interface.
- Event handling is based on delegation event model in AWT.
- Animation loop is created using the Swing Timer class which fires one or more action events after a specified delay.

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- Running a Swing-Based Applet: Find a 1.1 or 1.2 browser or download Java Plug-in into a supported browser. Make sure you have the latest version of the browser and plug-in. http://java.sun.com/products/plugin/
- Compiling and Running Swing Programs: It is recommended that you use the latest release of the Java 2 Platform downloaded from http://java.sun.com/j2se/.

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Start

Starting Angle [degree]: 45.0

Starting Velocity [m/s]: 10.46

http://www.pmfst.hr/~kim/Java/BasketBall/BasketBall.html

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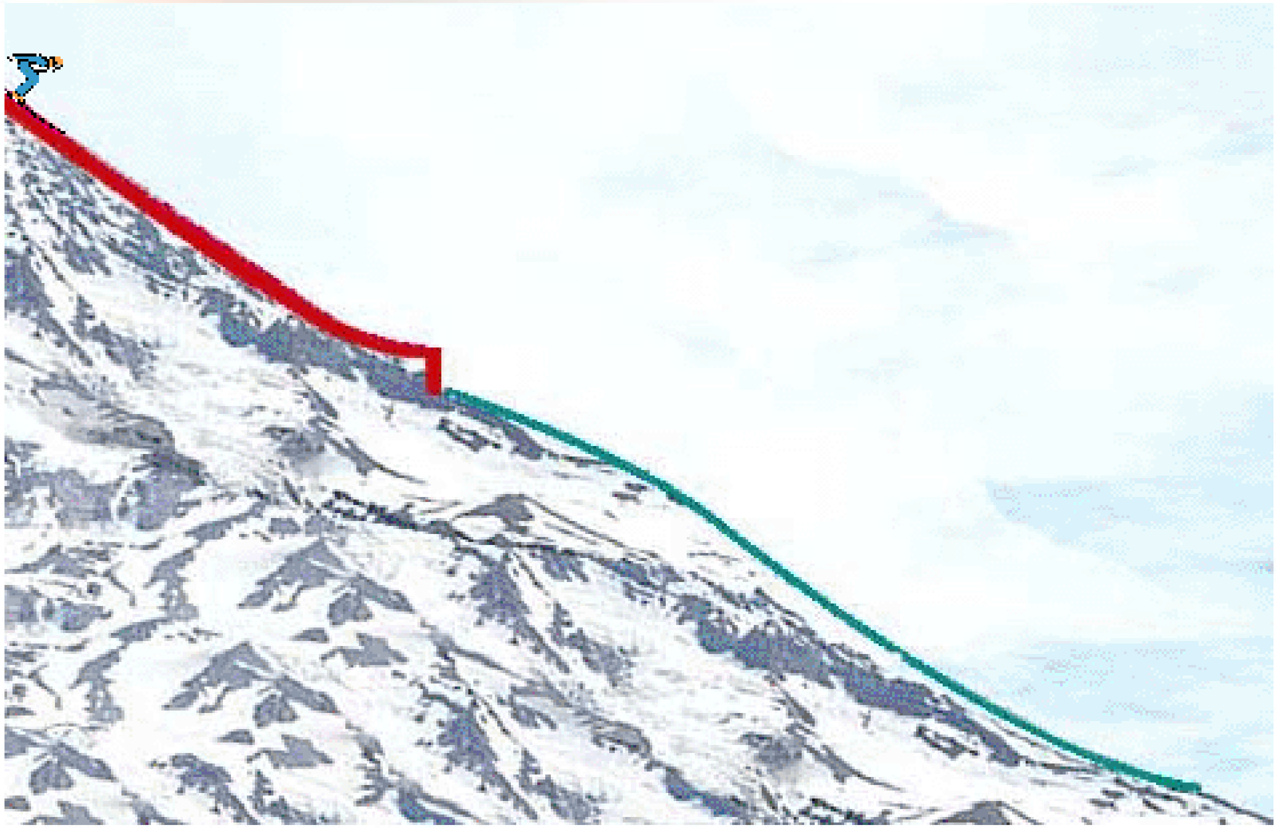

Start

Approach Velocity [km/h]: 90.0

Take-Off Velocity [m/s]: 3.0

Jumper's Position Angle [degree]: 28.98

http://www.pmfst.hr/~kim/Java/SkiJumping/SkiJumping.html

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Projectile Motion

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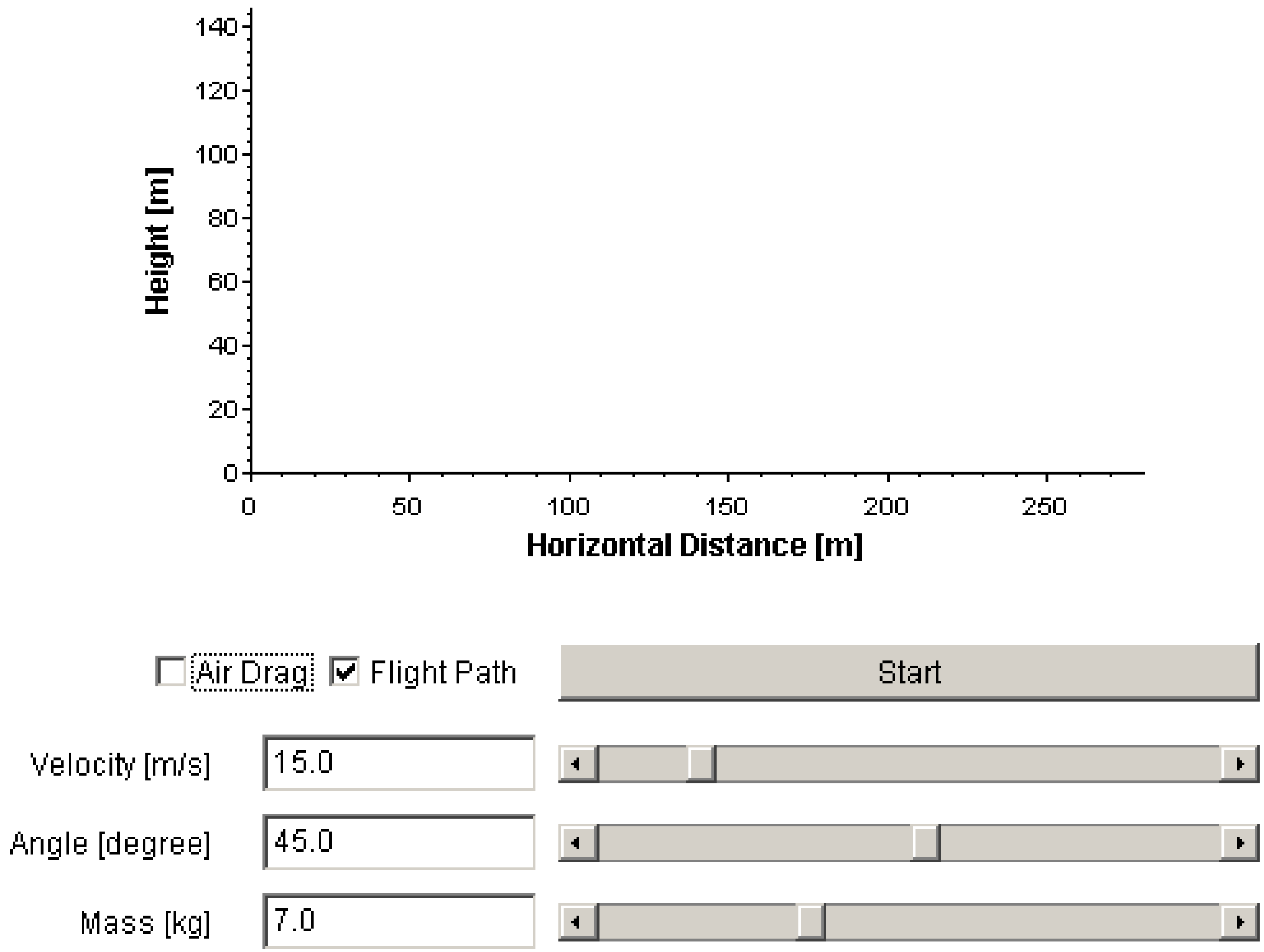

http://www.pmfst.hr/~kim/Java/Projectil/Projectil.html