Biomechanics of High Jumping

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bar clearance
takeoff run-up
bar clearance
takeoff
run-up

large vertical

long time
Δ $Z$

Height of the c.m. at the end of the run-up

Final speed of the run-up

<table>
<thead>
<tr>
<th>Height of the c.m.</th>
<th>Final Speed (m/s)</th>
</tr>
</thead>
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<tr>
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<tr>
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<td>3.5</td>
</tr>
</tbody>
</table>

Bar clearance
Takeoff
Run-up
height of the c.m. at the end of the run-up

final speed of the run-up

height of the c.m. at the end of the run-up

final speed of the run-up

height of the c.m. at the end of the run-up

final speed of the run-up
height of the c.m. at the end of the run-up

vertical velocity at the end of the takeoff phase

final speed of the run-up

vertical velocity at the end of the takeoff phase
vertical velocity at the end of the takeoff phase

height of the c.m. at the end of the run-up

vertical velocity at the end of the takeoff phase

height of the c.m. at the end of the run-up

vertical velocity at the end of the takeoff phase
ankle pronatio
QuickTime™ and a Sorenson Video 3 decompressor are needed to see this picture.

video courtesy Dr. Bart Van Gheluwe

bar clearance

actions in the translation
possible reasons for bar clearance:

- insufficient angular momentum
- insufficient arching
- bad timing of arching/un-arching
The airborne motions high jump are essential twisting somersault.

**twist rotation**

**somersault rotation**
Let’s see these rotations in an actual jump ...

We will look first at the twisting component of angular momentum.

QuickTime™ and a TIFF (LZW) decompressor are needed to see this picture.
We will look at how angular momentum is generated in an actual jump ...

We will now look at the somersault component of angular momentum.

somersaulting angular momentum
somersaulting
angular momentum

somersaulting
angular momentum

somersaulting
angular momentum

somersaulting
angular momentum
To understand how the somersaulting angular momentum is generated, we are going to break it down into two components, relative to the final direction of the run-up.
forward somersaulting
angular momentum

lateral somersaulting
angular momentum
lateral somersaulting
angular momentum
Let’s look first at forward somersaulting angular momentum ...
Now, let’s look at the **lateral** somersaulting angular momentum ...

The lean during the run-up is affected by two factors:

* the radius of the curve
* the speed of the run-up

The curve has two purposes:

* to make the athlete have a 
  away from the bar at the 
* to lower the c.m. without having to flex the legs very much
Summary of angular momentum:

- Twisting angular momentum
- Somersaulting angular momentum
The sum of the two is the somersaulting angular momentum, which we can see best in a view along the bar.

After the takeoff is completed, a lot of things are fixed:

The path of the c.m. is fixed.
Angular momentum is fixed.
But you still have a certain freedom ...

It’s also possible to some little bit faster by reducing moment of inertia about an axis parallel to the bar.

This can be done through changes in the configurations of the body or of the legs ...
One last thing:

There can be problems for the rotator cuff over the bar when an athlete uses strong double-arm and lead leg action during the takeoff phase ...

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needed for good technique:

* fast run-up
* low hips at end of run-up
* strong arm and lead leg action
* generate appropriate angular momentum
* body vertical at end of takeoff

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The End