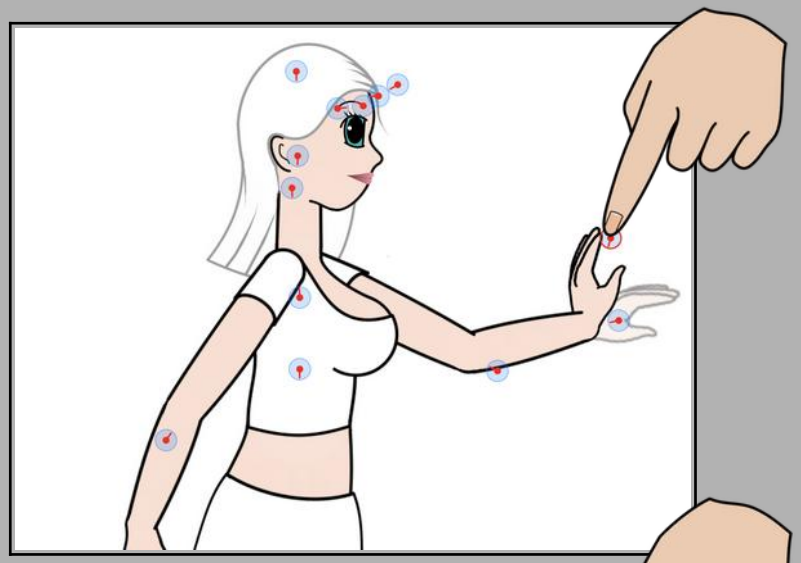
Kinematics

There are two types of kinematics typically used when animating figures, forward kinematics and inverse kinematics (please see below). In Animation Pro, forward kinematics are used by default. Inverse kinematics, however, can make it easier to animate your figures in a more natural way.

TOPICS:

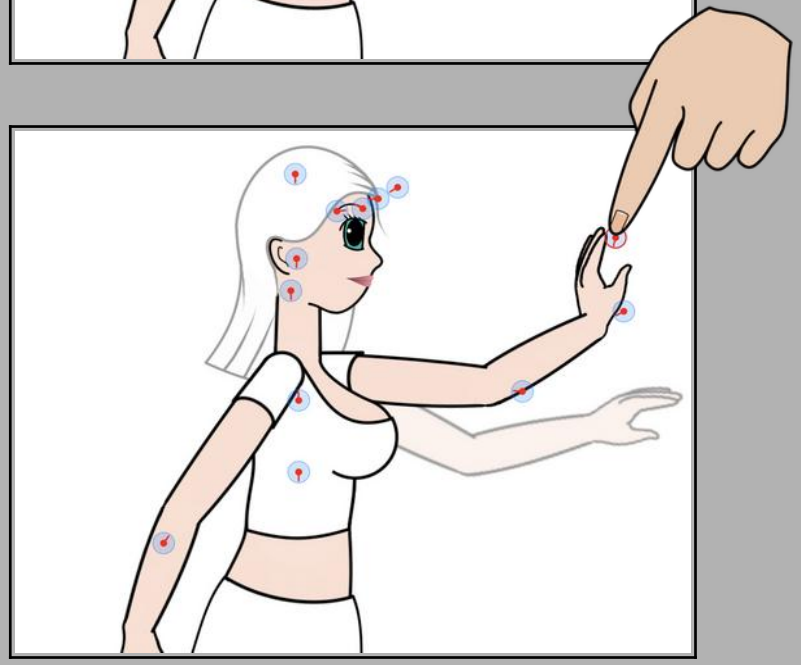
Forward Kinematics

If I try to move the figure's hand to a new position, the hand will only rotate about its pivot point.



Inverse Kinematics

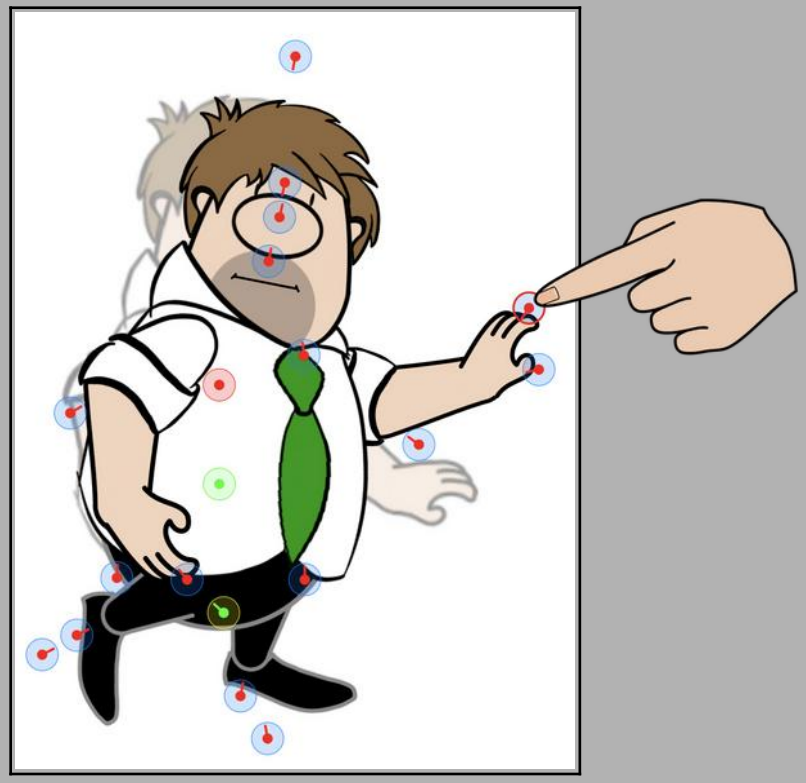
If I try to move the figure's hand to a new position, the hand's parent body parts (forearm, upper arm etc.) may also rotate in order for the hand to reach the new position.

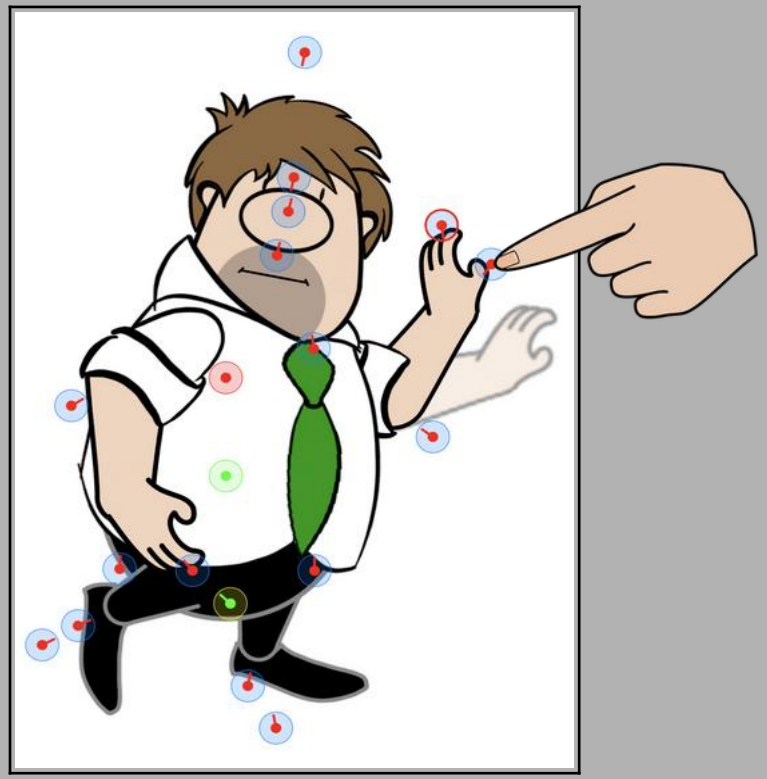


Kinematics Overview

For the sake of this help topic I'm going to use the figure of a man, provided with Animation Pro, whom I like to refer to as 'Bob'. He might not be happy about that name; he could, for example, have an acute phobia with respect to palindromes. But I'm going to run with it anyway.

Forward or inverse kinematics may be selected for each non-static item in a figure. So it's possible to have a Bob's hand use inverse kinematics whilst his forearm uses forward kinematics. In such a situation, dragging Bob's hand will potentially cause his forearm, upper arm and torso to move as well, as shown below. Moving his forearm, however, will only rotate his forearm about its pivot point (otherwise known as Bob's elbow).





Now this raises an interesting question: How much of Bob can potentially move when dragging his inverse kinematic hand?

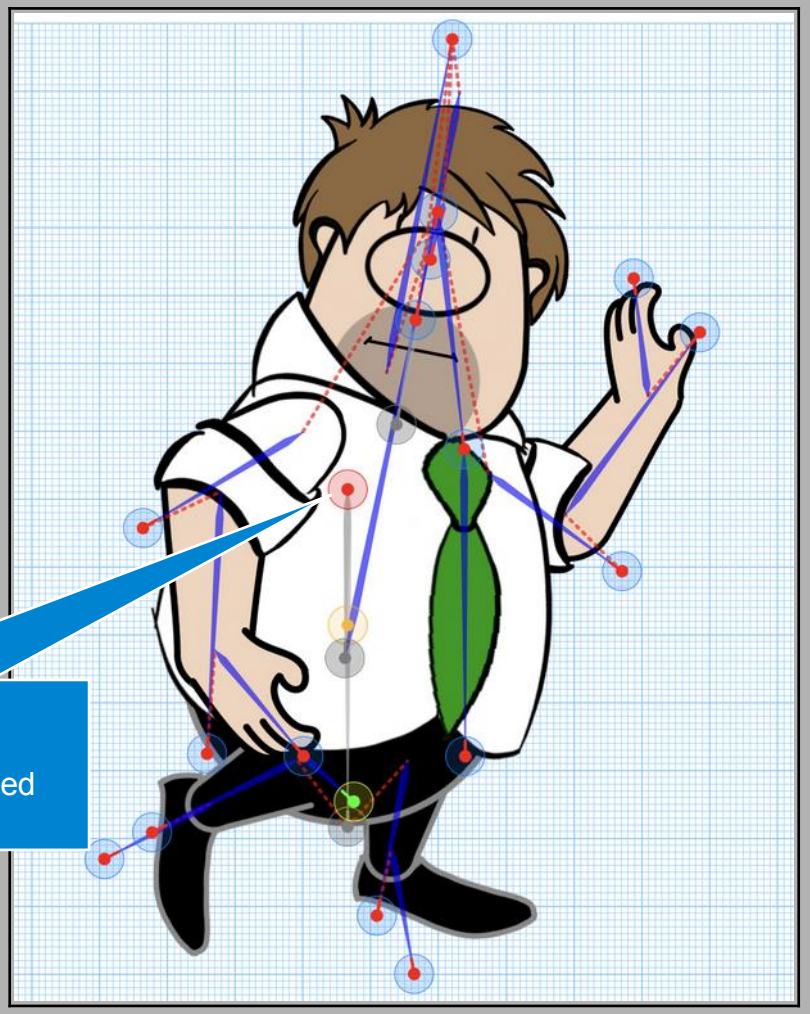
Animation Pro will move each parent item to Bob's hand (Bob's forearm, upper arm and so forth) until either:

1. The hand has reached the desired position

2. There are no more parent items i.e. the figure's hub has been reached

or

3. An item no longer exerts an inverse kinematics influence on its parent



Hopefully points 1 and 2, above, make sense i.e. there is no point moving Bob's upper arm if the movement of his hand and forearm place his hand in the desired position. And a figure's hub is the point to which all items in the figure are ultimately attached, so it has no parent. But what, exactly, is an 'inverse kinematics influence'???

Inverse Kinematics Influence

In Animation Pro, it is possible to configure how much inverse kinematic influence an item, in a figure, has upon its parent. If, for example, I configure Bob's hand to use inverse kinematics and tell it to exert 100% kinematic influence upon his forearm then dragging Bob's hand to a point that requires his forearm to move **will** move his forearm, no questions asked.

If, however, I configure Bob's hand to exert 0% inverse kinematic influence upon his forearm then it won't matter how much I try to move his hand, Bob's forearm simply won't budge.

Inverse kinematic influence values in between 0 and 100%, of course, will adjust just how hard you'll need to tug on Bob's hand to move his forearm (where 1% is really hard and 99% is not too hard at all).

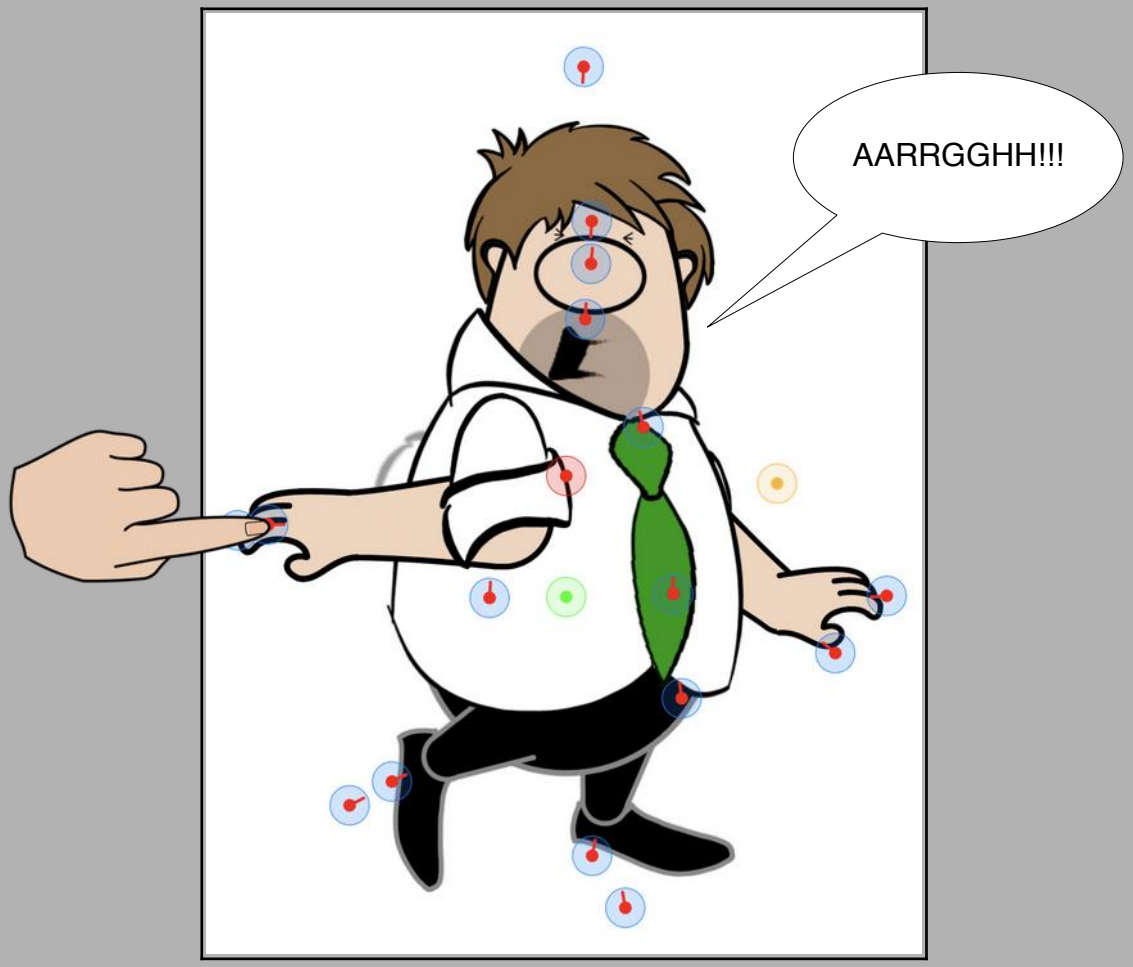
So when setting up the inverse kinematic influences for Bob, it might work best to set his hand and forearm to 100% (the default value) but set his upper arm to a much lower value, say, 10%. This will result in his hand, forearm and upper arm moving quite easily when his hand is dragged. Bob's torso, however, won't move unless you tug extra hard on his hand.

Please note:

It is not necessary to configure Bob's forearm and upper arm etc. to use inverse kinematics in order to assign them an inverse kinematic influence.

Constraints

By default, there's nothing stopping me from bending Bob's arm into what, for a regular human being, would be an extremely painful position:

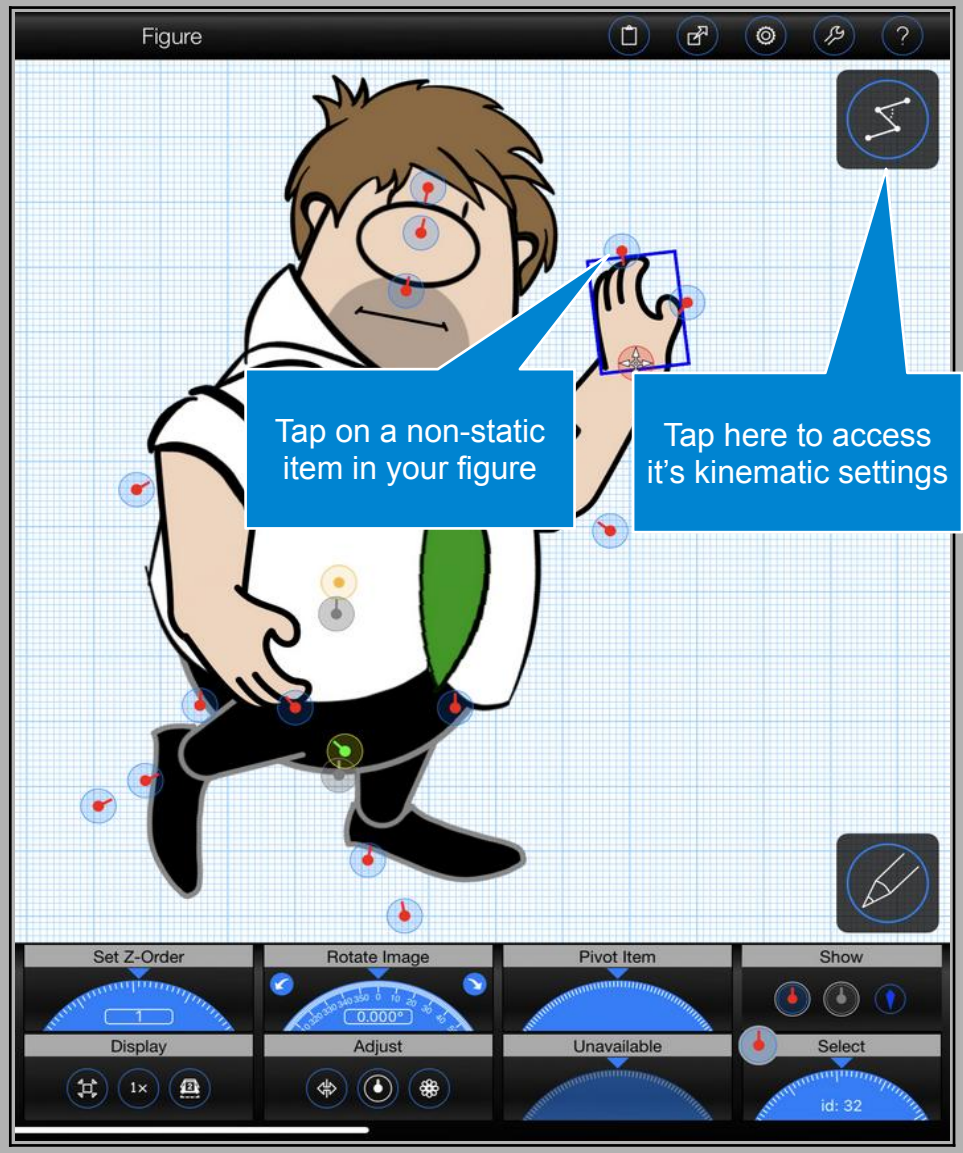


So Animation Pro allows animators to set constraints which dictate the allowable range of movement for each non-static item in a figure. Now, generally speaking, constraints serve little purpose when you're using forward kinematics (as you are unlikely to manually move an item into an 'impossible' position unless, of course, you are deliberately trying to break Bob's arm). When using inverse kinematics, however, constraints can stop 'impossible' positions from occurring as a result of moving an inverse kinematic item.

Accessing Kinematic Settings

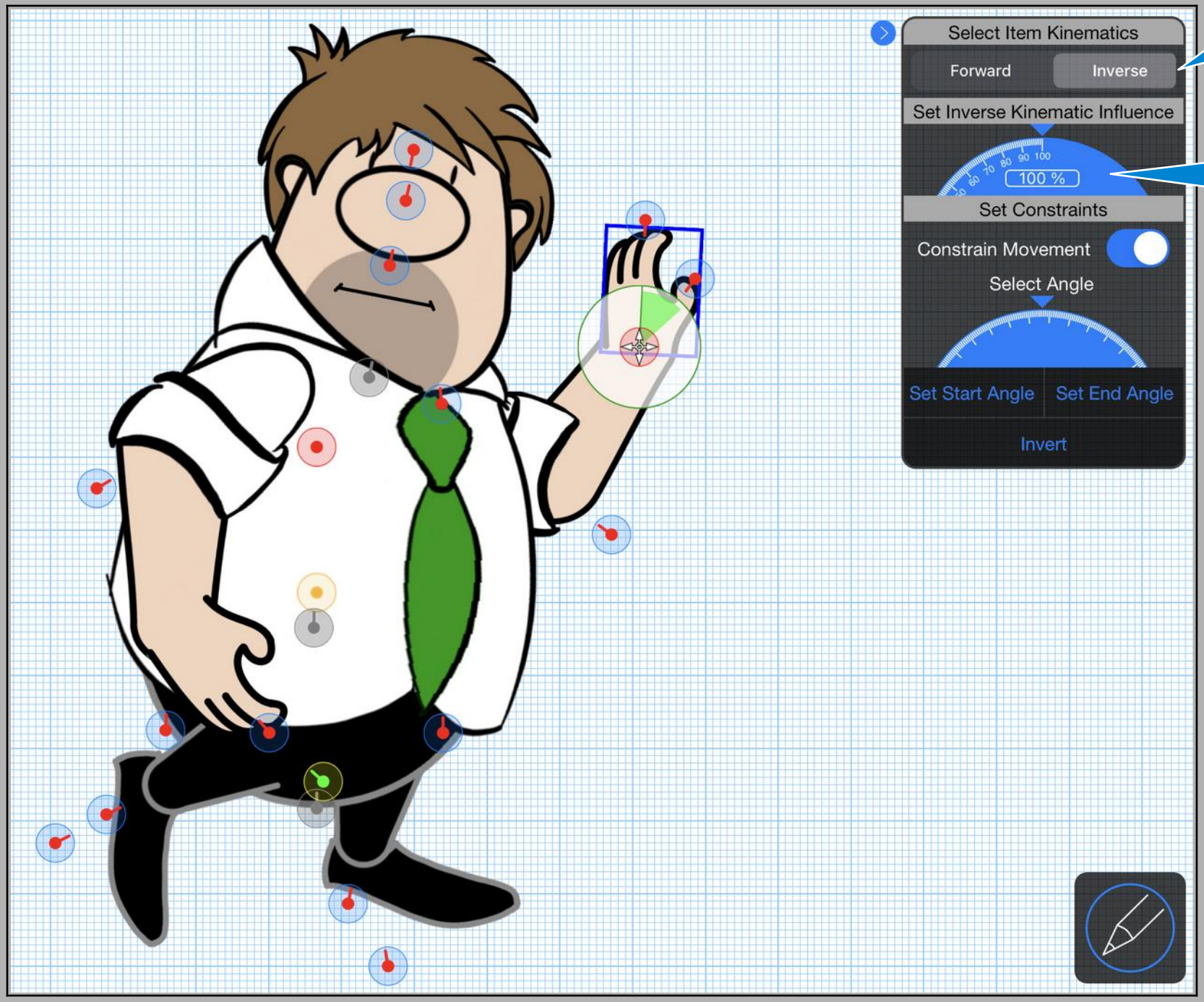
The kinematic settings for the items in a figure may be accessed either whilst creating figures or whilst animating.

Whilst Creating Figures:



Whilst Animating:

The Kinematic Settings



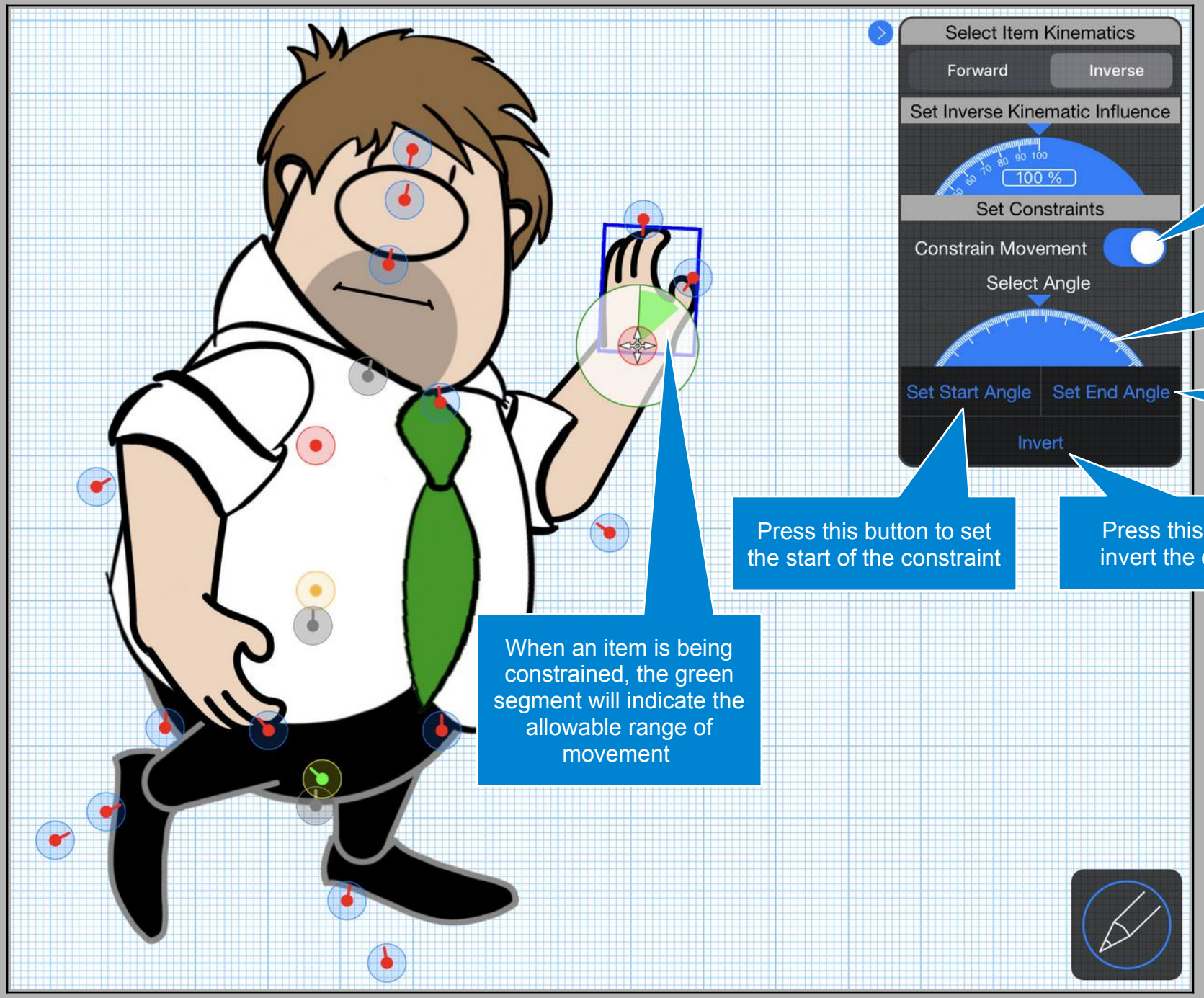
Select either “Forward’ or ‘Inverse’ kinematics

Select the inverse kinematic influence the selected item has on it’s parent

The Figure Editor is shown here.

The settings are the same on the Animation screen.

The Constraint Settings



The Figure Editor is shown here.

The settings are the same on the Animation screen.

Some things to note:

- We recommend that you set up the kinematics for the items in your figures whilst creating them. That way, the kinematics settings will be saved with your figures and you won't have to configure them every time you use those figures in new animations.

- If, however, you are updating an existing animation and would like to change the kinematics of an existing figure, then simply update its kinematic settings whilst animating. If you then save that figure, from the Animation screen, the updated settings will be saved with it.

- When you change the kinematic settings whilst animating, those changes apply to the figure across the entire animation, not just the frame you are editing.

- Kinematics have no (zero, none, zilch) influence on the way an animation is rendered. The kinematics settings only serve to make the posing of your figures easier when setting up the frames in your animation.

- Constraints have no (zero, none, zilch) influence on the way an animation is rendered. They won't, for example, prevent an item being tweened or keyed outside of the specified range of movement. The constraint settings only serve to make the posing of your figures easier when setting up the frames in your animation.