Computer Game Technologies

Animation in Java 3D

Animation in Java 3D

- *Animation* is a change without any direct user action
- Time-based animation
  - Interpolators
  - Alpha objects
  - Custom behaviours
- Collision detection
  - Same as for 2D
  - Bounding boxes and spheres

Time in Java 3D

- Java 3D rendering engine runs in a continuous loop at as fast a frame rate as possible
- WakeUp criteria
  - On elapsed time
  - One elapsed frames
- Alpha object
  - Value from 0.0 to 1.0
  - Value changes as a continuous function of time

Alpha Objects

- Synchronized against Java 3D system start time
- Four phases

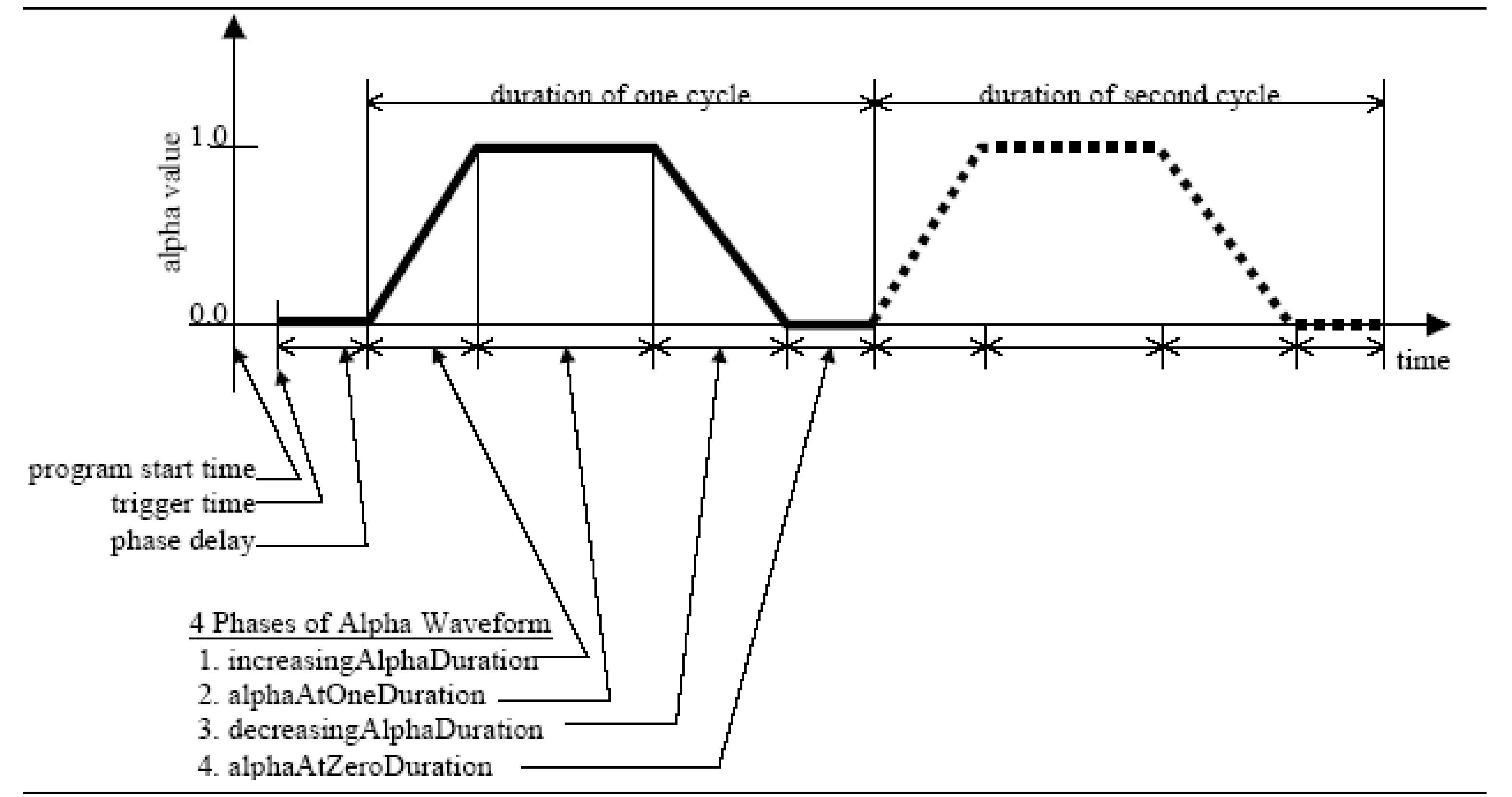


Figure 5-2 Phases of the Alpha Waveform.

Alpha Objects (2)

- Patterns using one to all four phases
- Fixed number of cycles or continuous

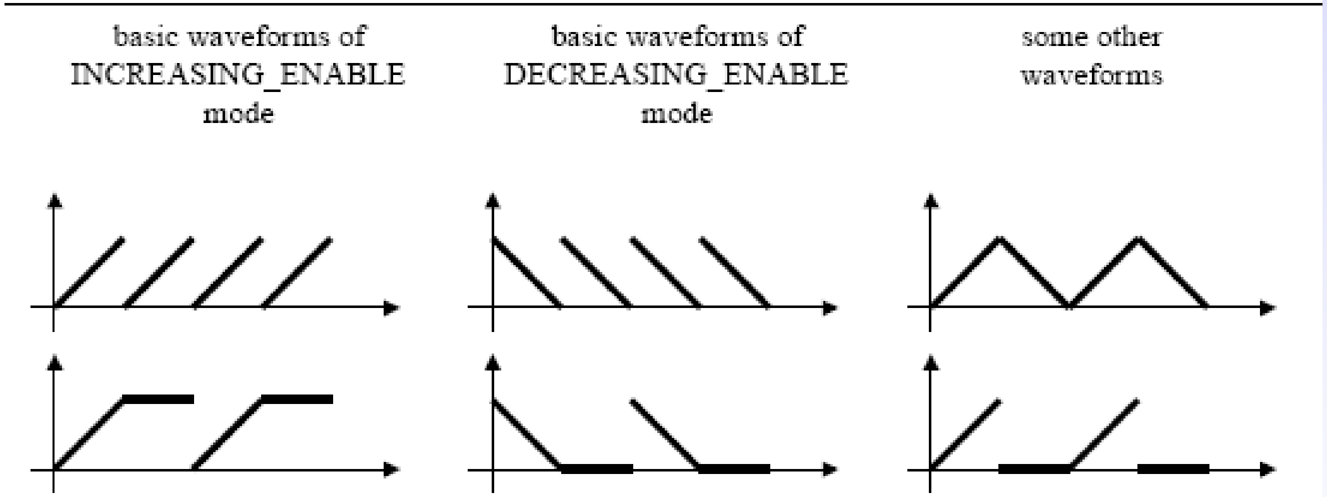

basic waveforms of INCREASING_ENABLE mode
basic waveforms of DECREASING_ENABLE mode
some other waveforms

Figure 5-3 Some Basic Waveforms Easily Made with an Alpha Object.

Alpha Objects (3)

- Waveforms can be smoothed
  - Useful for acceleration / deceleration effects

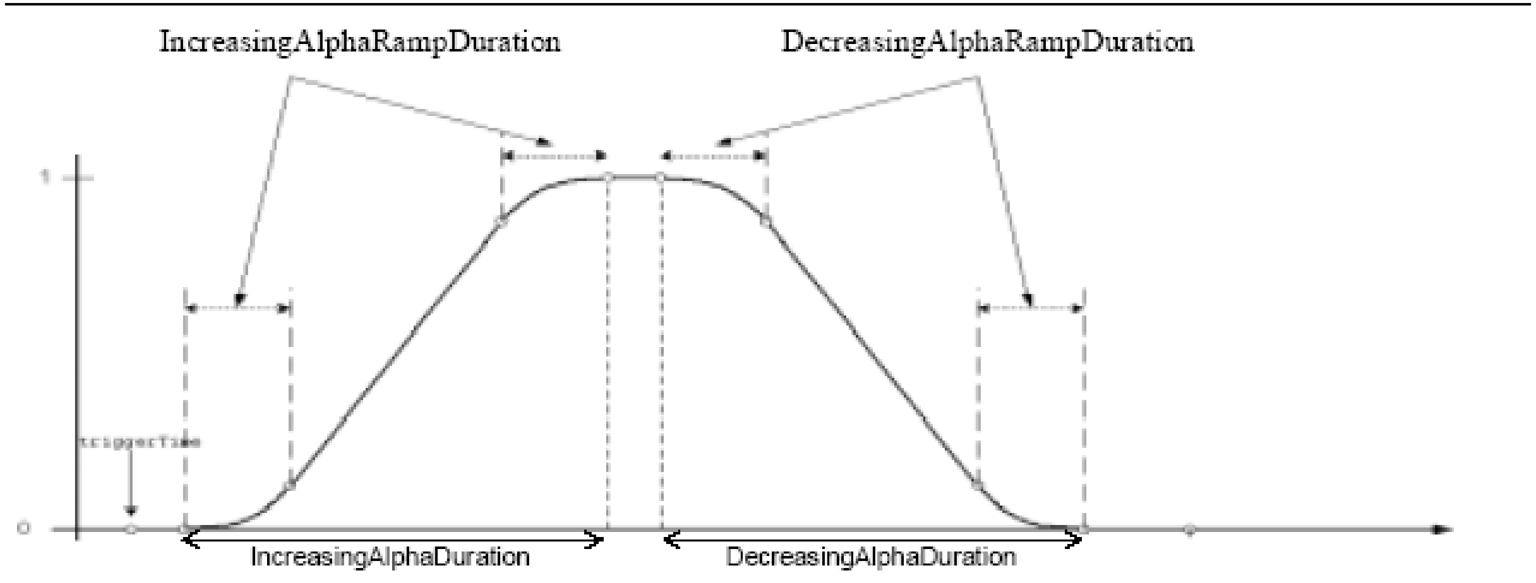
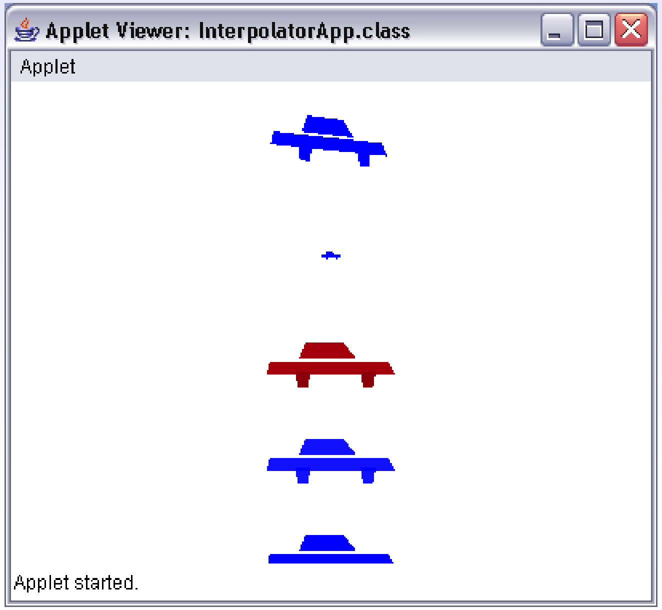
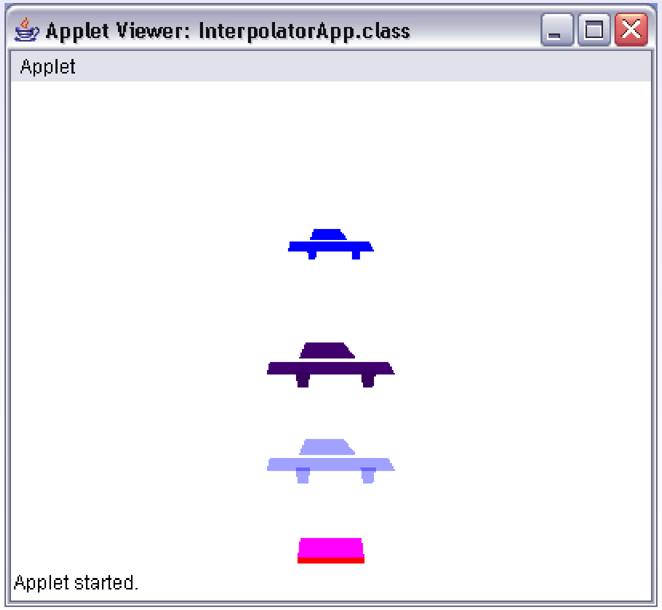


Figure 5-6 Smoothing of the Waveform Produced by Alpha[9]

Interpolators

- Change a property of a visual object
  - Location (translation) and orientation (rotation)
  - Size, colour and transparency
- Property changes over time
  - Interpolated against an Alpha object value





Built-in Interpolators

- Utility classes provided for interpolating most object properties of interest

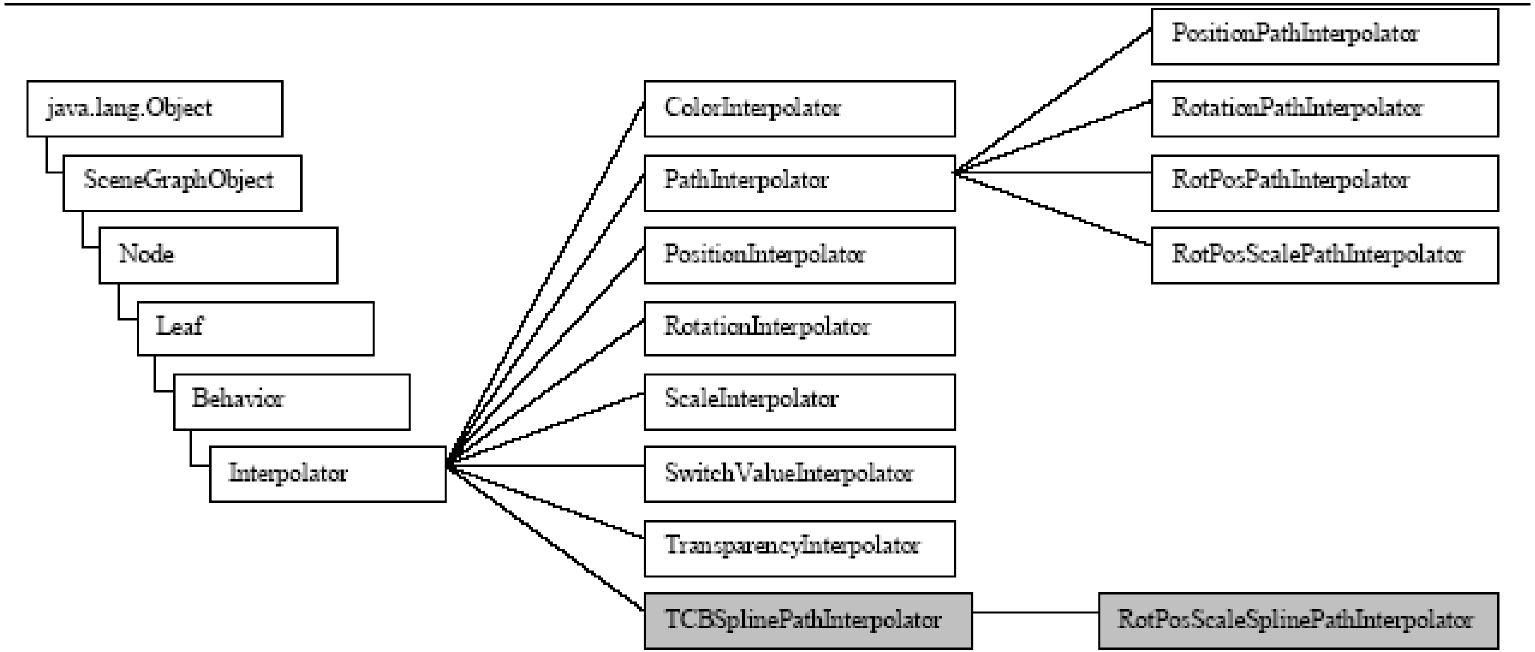


Figure 5-8 Java 3D Core and Utility (shaded boxes) Interpolator Classes Hierarchy.

Hand-crafted Animation

- Can write custom behaviours that use Alphas
  - value() method of Alpha object
- But movement in games is not always regular
  - Determined by interaction between sprites
  - Game state
- Custom animation behaviors using time or frame-based wakeup criteria
  - Identical to approach used for 2D games

The Animated Hand

- Davison, “Killer Game Programming” chapter 18
- Movement updated every few milliseconds via a custom behavior
- TimeBehavior has a reference to the AlienSprite object
- TimeBehavior calls the AlienSprite update() method every time it wakes up
- AlienSprite update() calculates the new sprite position based on location of player sprite and required distance to move on each update

TimeBehavior

```
public class TimeBehavior extends Behavior
{
  private WakeupCondition timeOut;
  private AlienSprite alien;

  public TimeBehavior(int timeDelay, AlienSprite as)
  { alien = as;
    timeOut = new WakeupOnElapsedTime(timeDelay);
  }

  public void initialize()
  { wakeupOn( timeOut );
  }

  public void processStimulus( Enumeration criteria )
  { // ignore criteria
    alien.update();
    wakeupOn( timeOut );
  } // end of processStimulus()
}  // end of TimeBehavior class
```

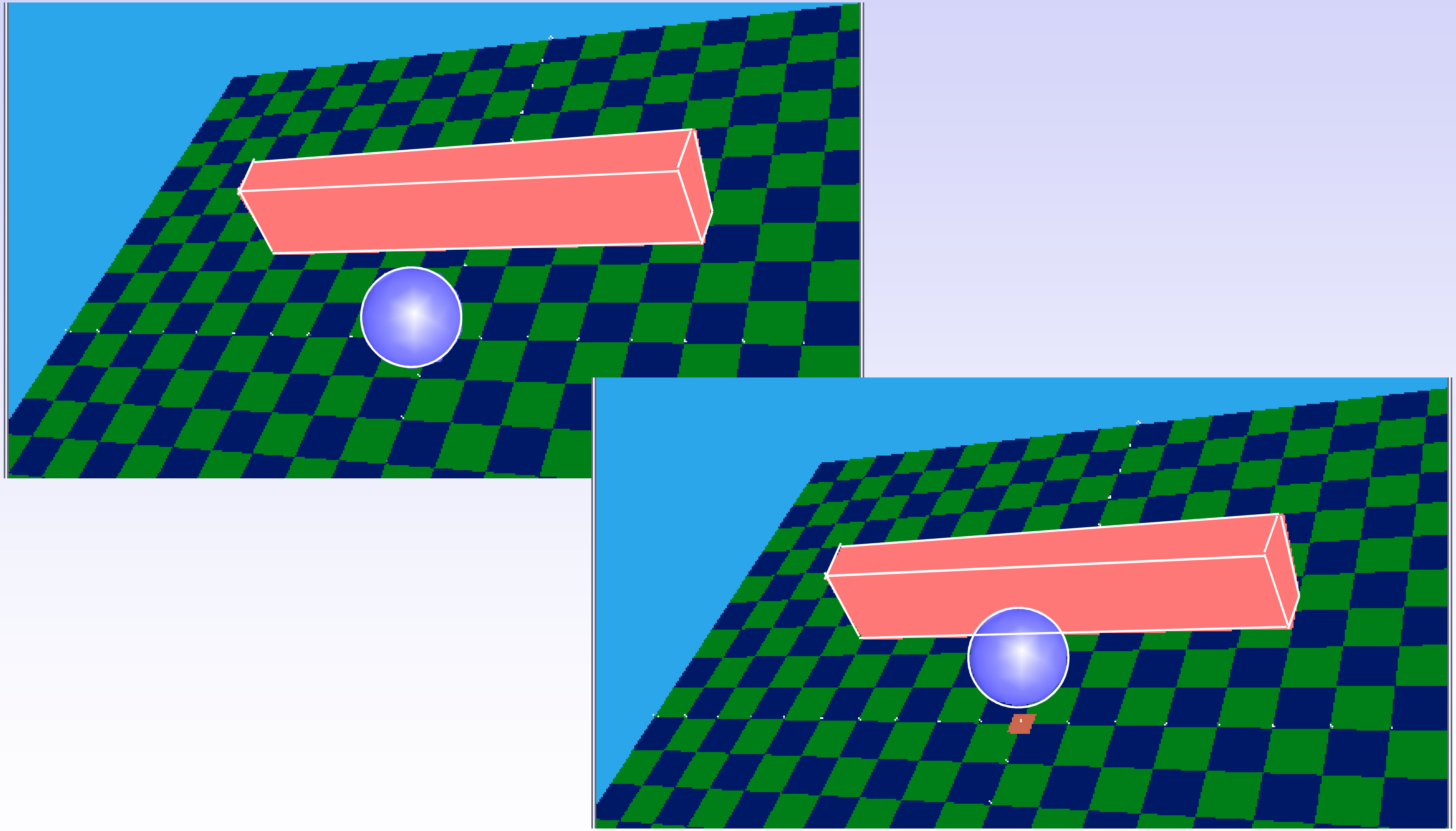
AlienSprite

```
public class AlienSprite extends TourSprite
{
  private TourSprite ts;
  private double currAngle;   // current y-axis angle

  public AlienSprite(Obstacles obs, TourSprite ts)
  {
    super(fnm, obs);
    this.ts = ts;
    currAngle = 0.0;
  }  // end of AlienSprite()

  public void update()
  // called by TimeBehaviour to update the alien
  {
    if (isActive()) {
      headTowardsTourist();
    }
  }  // end of updateSprite()
```

Collision Detection

- Collision detection based on bounding regions of objects
  - Boxes (cubes), spheres
  - More complex polytopes
  - Define explicitly for each object of interest
- Need to detect when bounding regions of colliding objects overlap
  - Bounding regions in Java 3D have a built-in method intersect() that can detect overlap with another bounding region
- Take appropriate action in response to collision

Collision Detection (2)



Example Time Behavior

```
public TimeBehavior(int timeDelay, TransformGroup oTG, float orad,
   Bounds obsBnds)
 // oTG is transform group of object to be controlled
 // orad is radius of object (for collision detection)
 // obsBnds is bounds of obstacle (for collision detection)
 {
   objectTG = oTG;
   collRad = orad;
   obsBounds = obsBnds;
   t3d = new Transform3D();
   toMove = new Transform3D();

   currMove = new Vector3d(0, 0, -MOVERATE);

   timeOut = new WakeupOnElapsedTime(timeDelay);
 }

 public void initialize()
 { wakeupOn( timeOut );
 }
```

Example Time Behavior (2)

```
public void processStimulus( Enumeration criteria )
{ // ignore criteria
  currMove = doMove( currMove );
  wakeupOn( timeOut );
} // end of processStimulus()

private Vector3d doMove(Vector3d theMove)
// Move the sprite by the amount in theMove
{
  objectTG.getTransform( t3d );
  toMove.setTranslation(theMove);    // overwrite previous trans
  t3d.mul(toMove);
  Vector3d trans = new Vector3d();
  t3d.get( trans );  // get translational component of transform
  Point3d newLoc = new Point3d( trans.x, trans.y, trans.z);
      // next location
  BoundingSphere testBnds = new BoundingSphere(newLoc, collRad);
  // only allow move if does not intersect with obstacle
  if ( !obsBounds.intersect(testBnds) )
      objectTG.setTransform(t3d);
  return theMove;
}  // end of doMove()
```

Collision Detection Recipe

- Give each object an associated bounding region
  - Cube, sphere
  - E.g. BoundingSphere playerbnds = new BoundingSphere();
  - When an object moves, its bounding region must be moved with it
    - Manually apply transform or recreate bounds at new location
    - Add bounds to a BoundingLeaf node
- Time-based behavior checks for *(predicted)* intersections between bounds of visible objects
  - Schemes for checking similar to 2D
  - E.g. if (playerbnds.intersect(enemybnds)) { fix collision }

The End