|  |  |  |
| --- | --- | --- |
| **AGH, WEAIiB** | **Advanced Python Programming** | Date  **17.01.2019** |
| **Systems modelling and Data analysis** | Topic:  Multibody collision | |
| Authors:  **Michał Morawiec, Patryk Jankowski, Kara Alparen, Pablo Castatno** | |

1. **Aim:**

The goal of our project was to prepare physical model presenting collision between few objects. Task has been divided into two problems, physical calculations and form of collisions presentation.

1. **Theoretical introduction:**

**2.1 Elastic collision:**

An elastic collision is a collision in which kinetic energy is conserved. That means no energy is lost as heat or sound during the collision. In the real world, there are no perfectly elastic collisions on an everyday scale of size. In an elastic collision, both kinetic energy and momentum are conserved (the total before and after the collision remains the same).

Conservation of momentum:

Conservation of kinetic energy:

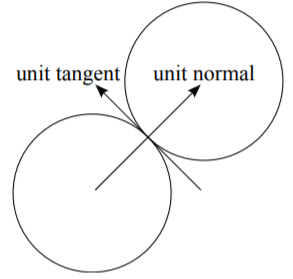
1. **Methodology description:**

During collision implementationg we have facing with two kinds of possible collisions: collisions between two circles and collision between circle and border. Each methodoly will be briefiley descripted below:

**3.1 Collision between two circles:**

To simplify model we have decided to treat out phenomena as simle elastic collision in two dimensions. We assumed that in our model we will have only one specific types of body – circle. Each body have velocity, mass, radius and coordinates. Used algorithm has been divided into 6 stages.

In stage one our goal was to find normal and unit tangent vector. The unit normal vector is a vector which has a magnitude of 1 and a direction that is normal to the surfaces of the objects at the point of collision Unit tangent vector is vector with a magnitude of 1 which is tangent to the circles' surfaces at the point of collision



First we have to find unit normal vector which is calculated with following formula:

, where

When we have obtained norma vector we can easily calculate unit tangent vector:

Stage two was based on resovling of velocity vectoris for each body into both components – tangential and normal, to perform this computations we have to calculate dot product, it is calculated according to following formulas:

, , ,

In stage three we have computed new tangential velocities. The tangential part of velocity have not changed during collision becouse there is no force between the circles in the tangential dirction. So we will simply assign values before collision to values after collision.