

1 Introduction

Physics engine is computer software that provides an approximate simulation of physical system. E.g. ODE - Smith (2001-2007), Bullet Physics- Coumans (2003-2016), Box2D - Catto (2007-2015) are open source physics engines that are widely used in areas where fast solutions are required. Typical industries are games and film productions.

Computational methods used in physics engines are divided to modules that handle collision detection and modules that handle simulation. In this work focus is on solving new types of constraints between rigid objects. Detailed description of various components can be found in e.g. Erleben (2005).

Plasticity is not typically taken into account in gaming solutions. Breaking of various objects typically takes place based on collision or impulse. Theory for handling of plasticity has been presented already in Terzopoulos and Fleischer (1998). Müller et al. (2004) presents a method for modeling and animating of elastic and plastic objects in realtime using point based animation but it is not widely used.

Goal of this work is to find method that can be used in widely used physics engines to make simulation more realistic by connecting rigid objects by spring based constraints which have additional properties for handling plasticity. Main feature is that plastic deformation takes place if force or moment exceeds given limit and deformation absorbs energy. This is done by reusing motor code that is already available in most physics engines.

Methods presented in this work can be used in gaming industry to provide more realistic simulations without significant extra work. This kind of methodology also opens quite large area of combining old structural analysis methods to modern simulation frameworks.

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