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Realistic Motion Synthesis of Free Falling Behaviours

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Free fall motions, such as fluttering (oscillate from side to side) and tumbling (rotate and drift sideways) of light-weight objects or objects in the strong resistance fluid with high Reynolds number, are spectacular and familiar but we lack the predicable and realistic simulation of the phenomena in computer animation and other related fields. We propose a new data-driven approach for procedural motion synthesis by using free fall motion graphs in interactive environments. Six primitive motions are defined based on $Re - I^*$ phase diagram and synthesized separately using trajectory search tree and pre-computed trajectory database techniques. About motion graph, we decide the motion classes of falling motion in designated initial conditions and the motion classes are constituted by primitive motions by discrete time Markov chain model. To get more natural and pleasing motion paths, we combine numerical simulation and experimental results of this topic from Physics. Depending on the data from thousands of experiments, we can simulate the unresolved physical problem, including chaotic motions or motions in three dimensional environments successfully by our approach.

We present in this thesis a framework that generates free fall motions for the object within fluid. We introduce a new motion synthesis approach based on primitive motions rather than motion segments, and then the motion

trajectory is specified form free fall motion graph. We automatically create motion groups from database. We propose a improved $1/f^{\beta}$ noise-based wind field method to achieve the wind-object interaction in real-time. The proposed approaches can produce realistic free fall motion that could be applied in many different applications, including virtual reality, game and other entertainment productions.