# A Laban movement approach to creating expressive motion in animated soft-body agents


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**Figure 1: Variations of an idle animation with a soft body character, the kinesphere scaffolding has various regions that are encoded with bone positions of the soft body agent. Variations from the original animation (left) can be seen in the head (center), torso and arm areas (right). The deformations can be serialized and reused at a later time indexed by a Laban personality.**


## ABSTRACT

Can an intelligent animation system create expressive torso animations for skeletal based animations? If so what kind of metrics or rubric would it use for humanoid and non-humanoid agents? We address both theses facets of interactive animation in this paper by allowing a Laban projection scaffolding (known as a Laban kinesphere: a kinesphere is a platonic solid specifically a icosahedron) on a characters body space to allow for modular and expressive movements beyond the canned animations provided. Furthermore, we implement a volumetric physics dynamics component to create real-time collisions and force based actuation based on the projections provided in the scaffolding.


## 1 INTRODUCTION

The computational resources available for simulating physically-based characters in real time have improved markedly in recent years, both in terms of detail of material simulations as well as for creating animations procedurally. In this paper, we introduce a framework for procedurally generating novel movement sequences for a soft-body character in 3D game environments. Such a character consists of a lattice of simulated particles, grouped into shapes that can be used for linear blend skinning of a mesh.


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Our work uses Laban's Space component and outlines a pipeline for an improvisational AI agent that is articulated by multiple bone transforms in a Particle lattice and has its torso and limbs projected onto a icosahedron to analyze them in terms of the geometric properties regarding the agent's personal space.

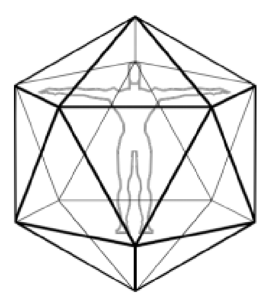

**Figure 2: An illustration of a laban icosahedron scaffolding engulfing a humanoid character**

The agent can manipulate the projections to generate various alternatives by altering the amount of forces applied to particles. We describe the structural design and the encoding schemes for the framework. Our system provides an alternative way to reason about movements for physically-based characters–i.e. by understanding them in terms of space. This deepens the system's understanding of the character's intentions and behaviors while using its torso and limbs to gesture.

Allowing agents to draw on improvisational dance theory to dynamically generate simulated behavior of soft body torsos in novel situations. Similar work for traditional bone-based animation has shown promise [Gujrania et al. 2019]. We would like to extend the applicability of Laban's movement rubric to non-humanoid shapes as well.

Using Laban movement analysis in IK-based characters has been done before by using the space component [Gujrania et al. 2019] or via drives in motion augmentation of the space body component [Durupinar and et al. 2016], both experimented in imparting a personality-driven tuning to humanoid motions. Physics and lattice particle simulations provide a squash and stretch to the character [Rivers and James 2007] by allowing mesh deformations that when controlled can produce expressive results that can portray a certain personality during appropriate contexts. Previously deformable characters were made to move with data driven models and cage-based deformers [Corda and et al. 2020; Coros and et al. 2012].

## 2 METHODOLOGY

First we animate a soft body asset in Nvidia Flex using a skeletal rig from a reference animation.

**Figure 3: The animated volumetric soft body character moved with forces**

Then a soft body character with its multiple joints is circumscribed in a virtual icosahedron and its joints projected onto the icosahedron scaffolding. This projection allows the system to define the gestures from the reference animation and the physics animation in terms of the physical parameters of the scaffolding, dividing the space into a three-by-three-by-three grid inside the shape.

Detecting bone transformations in said zones, the system can present the animator with several possible variations of the base animation. Different zones feature more prominently for different personalities, as described with Laban's kinesphere.

Movement of the torso in certain zones of the icosahedron denote certain expansive or retreating traits, the animator can tweak

**Figure 4: The arms of the soft body creatures deformed and encoded in the medium zone of the vertical and sagittal planes, while also being in the left and right zones of the horizontal plane, we have allowed for encoding only the arms and head in zones of the icosahedron**

movements by denoting new zones and joints to project on those zones based on other personalities or context. The system can apply forces to chunks of particles, perform free-form deformations by dragging and locking single particles in local space in order to modulate motions and use the physics system.

The appropriate movement variations that the animator chooses are then stored by the system for future reference. The next time a player reaches the point in a game where the character throws its arms in the air and jumps, the system could select one of the variations generated by the improviser, leading to a different experience for the player.

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