Adaptive Motion Synthesis and Motor Invariant Theory

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Abstract

Motion Synthesis is a challenging and valuable problem.

In this paper we propose a novel method based on some biological research.

Chapter INTRODUCTION

1 the problem of motion perception and motion synthesis

How animals move is an fascinating question.

Which is old but still questions the nowadays people.

Besides our old fancy dream, it is also of great important in nowdays.

Advance in this topic will greatly influence the biology, robotic engineering and

Also intelligent research.

It is also of one of the most challenging question in computer animation research.

We are so familiar with motion of human and animals; we can easily identify the artefacts of motion but still don’t have an idea of how motion is synthesized.

Across the whole discipline, motion synthesis or motor control in biology terms is full of paradoxes.

Before going into details into the research ideas, we first review some fundamental questions in motor controller.

1. The first problems comes the dof. Unlike the artificial system, bioligcal system has a much more degree of freedom. Artificial ship is a fixed rigid body, while biological fish has much more dof than ship, the vebrae is quite flexible, and has many degree of freedom than it artifical component. In principle, we know that more degree of freedom will make the animals generate more motion and adaptive to the environment, but from the control viewport, such degree of freedom propose a challenging problem to the control system, for human, how can the biological control system control more than 200 bones and 600 muscles to finish just one step walk.
2. The second problem comes from you dexourity of our motion ability.

Human can carried out many motion task than the artificial system.

Beside the walking ,swimming and object manipulation which are treated as motor motion task, the feeding, breading, language, vision also involves lots of motor control. Besides of all these, human can also utilize a large of artificial tool, driving a car ,skate, and cycling, and play tennis, all these ability depends on the motor control.

Human and animals exhibit a variety of motion tasks which will astonish the most artificial system

1. The third problem of motor control is our motor perception system.If we acquire many motion tasks through learning, what we see is closely related to what we learn and how we learn our motion ability. A interesting phenomenon in human motion perception is motion perception is quite selectable. For some minor motion mistakes we will identify them instantly, while for some impossible motions, we don’t seem to notice the artefacts. What we see is what we learn?

An important question is if the artefacts neglected is because they are not important?

We are very familiar with motion of human or other animals,

But familiarity doe not mean well understanding, if look closely,

We will have to recognize we know little about the biological motor control,

2 rethink about motion synthesis research

For computer animation research, the key principles is we should know the things we animate, if not so we will faces lots of troubles in generating animation.

Natural motion system has many valuable properties which are not captured by our current motion synthesis system

What natural motion looks like?

1 adaptive and robust

2 realtime performance

3 energy efficient

To design a motion synthesis framework, we facing the several key problem.

1 Memory or thinking

The first question is how where we get our motion task, whether because we through memory, given some much motion details, it seems impossible for us to remember all the motion data. If motion is based on thinking our reasoning power, it will put an heavy burden on our brain.

Feedback or feedforward

The second is which control strategy plays more important role in motor control, feedback or feedforward. Most artificial or ariticial control theory is feedback based, if so, human motor system must have a power sensing system are accurate but also high speed. Which seems troublesome. A different control idea is feedforward based control,feedforward control can get rid of all the sensing accurary and speed, which our human are not good, it depends on the prediction and experience, which our human beings are fond of since the old day.

Disadvantage or Advantage

Maybe the most important problem we should rethink is the attitude toward the body structure. The body structure is the result of natural selection of millions of years, seen in this way, the body structure is heritage rather than a burden, somehow, we may think the body structure is an over powerful tool beyond our current comprehension, a complex system does not necessarily difficult to use. it is not that the nature make a big mistake, it is we don’t understand the great design yet.

1. overview of a different motor control framework

in this research, we propose a different motion synthesis system based on a different motor control idea.

We have an insightful founding is that motor control can be an easy task.

For some situation,such motion tasks can be achieved without any control effort.

By exploring the properties of the body and environment, some motion tasks are simple and easy to control. We don’t really carry difficult motion tasks, we just select many simple motion tasks and modify them for our special needs.

Such simple motion tasks are called motion primitives, when we modify the motion primitives, we must keep some valuable properties of motion primitives unchanged, the maintained property is called motor invariant.

1. in this paper, we propose a different motion synthesis. The inspiration of our knew method comes from a different biological viewpoint upon the biological body system and neural control.
2. a simple example
3. the ship example for qualitative dynamics
4. the mass-spring example for symmetry.

5 organization of the paper