3-2017

Physical Induction Explains Why Over-Realistic Animation Sometimes Feels Creepy

Olga Kosheleva
The University of Texas at El Paso, olgak@utep.edu

Vladik Kreinovich
The University of Texas at El Paso, vladik@utep.edu

Comments:
Technical Report: UTEP-CS-17-28
Published in *Journal of Innovative Technology and Education*, 2017, Vol. 4, No. 1, pp. 65-70.

Physical Induction Explains Why Over-Realistic Animation Sometimes Feels Creepy

Olga Kosheleva and Vladik Kreinovich
University of Texas at El Paso
500 W. University
El Paso, Texas 79968, USA
olgak@utep.edu, vladik@utep.edu

Abstract

In the past, every progress of movie animation towards realism was viewed positively. However, recently, as computer animation is becoming more and more realistic, some people perceive the resulting realism negatively, as creepy. Similarly, everyone used to welcome robots that looked and behaved somewhat like humans; however, lately, too-human-like robots have started causing a similar negative feeling of creepiness. There exist complex psychology-based explanations for this phenomenon. In this paper, we show that this empirical phenomenon can be naturally explained simply by physical induction – the main way we cognize the world.

1 Realistic Animation Is Creepy: An Empirical Phenomenon

With technical and artistic progress, it is possible to make movie animation more and more realistic. In the beginning, a description of human beings in movie animation was not very realistic.

As the new techniques develop – especially techniques of computer animation – it has become possible to have more and more realistic movie-animation description of humans.

In the beginning, this progress towards realism was viewed positively. At first, the resulting progress towards more realistic animation was viewed mostly very positively, both by the critics and by the regular movie goers.

Lately, an increase in realism is often viewed negatively. However, as it became possible to make animation of human beings very realistic – almost real – suddenly, movie goers started viewing this almost-perfect realism as creepy and negative; see, e.g., [1, 2, 3, 4, 5, 6].

Similarly, robots originally did not look like humans. When it became possible to make them similar to humans, this was at first viewed positively. However, as it has come possible to make robots which look almost exactly like humans, the resulting almost-human robots are perceived as creepy.

But why? To the best of our knowledge, while there are complex psychology-based explanations for this empirical phenomenon, there seems to be no simple and convincing explanation for the observed creepiness.

In this paper, we enhance the arguments presented in [1, 3, 4, 6] and show that physical induction – the basis of all our knowledge about nature – provides a natural explanation for this strange empirical phenomenon.

2 Physical Induction: A Brief Reminder

Need for predictions. One of the main objectives of science and engineering is to make predictions about the future state of the world. Such predictions enable to use to make decisions for which the resulting future state of the world is the most beneficial for us.

How do we make predictions? We usually make predictions based on perceived laws of nature.

We know that a body left handing in the air will fall down. So, we predict that if we through a ball out of the window, it will eventually reach the pavement below.

We know that the voltage V is equal to the current I times resistance R. So, we predict that if we send a current of 2 milliAmper through a resistor with resistance of 3 kiloOhm, we will observe the difference of voltages on the two sides of this resistor equal to $V = I \cdot R = (2 \cdot 10^{-3}) \cdot (3 \cdot 10^{3}) = 6$ Volts.

But how we do learn laws of nature: need for physical induction. How do we know that an object left hanging in the air falls down? A simple explanation is that we have observed phenomenon many time.

First time, we may have considered it a coincidence. Second time, we may consider it a coincidence. However, after we have observed the same behavior many time, we end up believing that this is indeed a general law of nature.

Similarly, when Ohm observed that in one experiment, the voltage V was equal to current times resistance, he may have considered it a coincidence. However, after he repeated similar experiments many times and got the same dependence $V = I \cdot R$ every time, after others performed similar experiments and got similar results, we have started believing that the formula $V = I \cdot R$ is indeed a general law of nature.

This reasoning is known as *physical induction*: after we observe many cases of a certain phenomenon (and no cases in which this phenomenon does not happen), we conclude that this phenomenon will happen in all future situations as well.

Comment. Of course, in reality, physical induction can lead to wrong consequences.

From the purely mathematical viewpoint, this is easy to explain. For example, if we measure weights of different natural objects with high accuracy, the probability of observing something that weighs exactly 1.200 kg is very small. Thus, most probably we will never observed exactly this weight in a first few measurements. However, if we conclude that such weights are not possible, we will be wrong: we can always attain such a weight by taking a similar smaller weight and adding the material gram by gram.

A more serious example is that Newton's physics was confirmed by millions of experiments – however, in the 20th century, it was shown that in some practical situations, the predictions of the Newton's physics are inaccurate: we need to take into account quantum and/or relativistic effects.

In applying physical induction, it is important to take into account that events are never identical. Physical induction is sometimes applied to cases when we have several absolutely identical situations.

However, in most cases, the situations are not absolutely identical, they are slightly different. For example, when we repeatedly suspend bodies in the air, we may have different bodies, suspended at different heights, etc. Similarly, in different experiments that led to Ohm's law, we had resistors made from different metals, of different length, width, different spatial orientation, etc.

In short, physical induction is not (only) about a series of identical situations, it is also about a series of *similar* situations. If in this series of similar situations, we repeatedly observe the same phenomenon, then we conclude that the same phenomenon will occur in similar situations in the future.

3 Resulting Explanations of Why Realistic Animation Is Creepy

Physical induction and our recognition of human beings. Physical induction is not only about physical laws, it is the basic principle underlying our behavior in general.

For example, we learn that if we see some object strongly resembling a human being, then it is indeed a human being – and we should behave accordingly. How do we know this? Many times in the past, whenever we observed something resembling a human being, we found out that it was indeed a human being.

On the other hand, if we see, e.g., an ape – which has some features of a human but not much – we conclude that this is not a human being, and we behave accordingly.

There is a threshold. In other words, there is some threshold similarity degree d_0, so that:

- if we see an object x whose degree of similarity to humans $d_h(x)$ exceeds this threshold value – i.e., for which $d_h(x) \geq d_0$ – we automatically conclude that this object x is a human being, and behave accordingly;

- on the other hand, if we see an object y for which $d_h(y) < d_0$, we automatically conclude that this object y is *not* a human being.

In the natural world, this threshold works well. These two rules work perfectly well in the natural world, since in the natural world:

- we either have human beings x, for which $d_h(x) \gg d_0$,
- or we have objects y which are not human beings and for which

$$d_h(y) \ll d_0.$$

With realistic animation and human-like robots, we get confused. While the above two rules work well in the natural world, it has become possible to come up with animated human beings and/or human-like robots y for which the degree of similarity to human beings $d_h(y)$ is very high – namely, higher than the corresponding threshold d_0.

In this case:

- while we know that these are not real human beings,
- our intuition tells us in no uncertain terms that they are.

This contradiction is what makes over-realistic animations and too-human-like robots viewed negatively – as "creepy".

Comment. This is not just about human faces and human figures, it is about a contradiction in general.

For example, when I see a teacup, I know that is an inanimate object:

- I can move it from one place to another,
- I can pour tea in it and drink tea from this cup, etc.

I also know that a teacup will not move by itself.

Thus, if I observe the cup starting moving by itself – as in horror movies – this will bring in the same negative feelings of "creepiness".

Acknowledgments

This work was supported in part by the National Science Foundation grants HRD-0734825 and HRD-1242122 (Cyber-ShARE Center of Excellence) and DUE-0926721, and by an award "UTEP and Prudential Actuarial Science Academy and Pipeline Initiative" from Prudential Foundation.

References

[1] T. J. Burleigh, J. R. Schoenherr, and G. L. Lacroix, "Does the uncanny valley exist? An empirical test of the relationship between eeriness and the human likeness of digitally created faces", *Computers in Human Behavior*, 2013, Vol. 29, No. 3.

[2] N. Kageki and M. Mori, "An uncanny mind: Masahiro Mori on the Uncanny Valley and beyond", *IEEE Spectrum*, 2012.

[3] M. B. Mathur and D. B. Reichling, "Navigating a social world with robot partners: a quantitative cartography of the Uncanny Valley", *Cognition*, 2016, Vol. 146, pp. 22–32.

[4] R. K. Moore, "A Bayesian explanation of the 'Uncanny Valley' effect and related psychological phenomena", *Scientific Reports*, 2012, Voil. 2, Article 864.

[5] M. Mori, "The uncanny valley", *Proceedings of the 2005 Humanoids Workshop: Views of the Uncanny Valley*, Tsukuba, Japan, December 2005; reprinted in *IEEE Robotics and Automation*, 2012, Vol. 19, No. 2, pp. 98–100.

[6] Y. Yamada, T. Kawabe, and K. Ihaya, "Categorization difficulty is associated with negative evaluation in the 'uncanny valley' phenomenon", *Japanese Psychological Research*, 2013, Vol. 55, No. 1, pp. 20–32.