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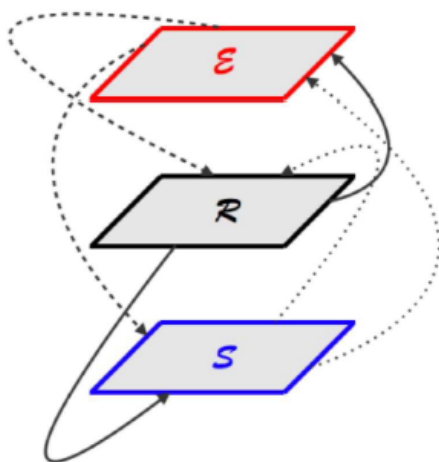
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Wednesday, May 12, 2010

First Mathematical Model of Cow Behavior

Thinking about cows as simple coupled oscillators leads to a model that predicts how they stand up or lie down in synchrony.



Many creatures demonstrate various kinds of collective behavior: birds flock, fish shoal, cattle herd and even humans collaborate from time to time.

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Determining the dynamics of this kind of behavior is a hot problem that has lead to a number of fundamental discoveries in recent years. Who would have imagined that bacterial colonies cooperate when they grow, that shoals of fish can make collective decisions and that an insect swarm can act seemingly as one? And yet the mathematics that describe these systems demonstrate how easily this kind of behavior can emerge.

Today, the mathematics of animal synchrony takes a cloven-footed step forward with the unveiling of a model that describes the collective behavior of cows.

Cows are well know for their collective behavior: they tend to either all lie down or all stand up for example. Jie Sun at Clarkson University in New York state and colleagues say that this behavior can be modelled by thinking of cows as simple oscillators: they either stand or lie and do this in cycles. These oscillators are also coupled: one form of coupling may be that a cow is more likely to lie down if those around it are lying down and vice versa.

The result is a mathematical model in which the collective behavior of cows can be studied in abstract.

That may turn out to be more useful than it sounds. Happy cows tend to copy each other. And happy cows are also more productive by various measures such as the amount of milk they produce. Some researchers have even proposed that synchrony be used as a measure of the quality of bovine life.

The new model may help understand this. The model indicates that synchrony does not depend on the strength of coupling in a simple way. In fact, it predicts that an increase in coupling can reduce the level of synchrony.

That will ring a bell with many farmers who keep their cattle indoors during winter. They have long recognised that when cattle are so crowded that there is not enough room for them all to lie down at the same time, productivity drops dramatically. In fact, in some parts of the world there are rules about how much space cattle must have to lie down in.

The new model could help determine the level of coupling that maintains production.

That of course depends on the nature of the coupling between cows. Perhaps cows simply copy their neighbours and feel more strongly about it, the closer they are together. That's something that could be measured. Researchers have used Google Earth images to study the patterns cows make when they line up. The same images might reveal how coupling depends on intercow distances.

But there may be other factors at work. For example, it would make sense if a few cows in a herd always remained standing to look out for predators and indeed this behavior is sometimes observed.

On the other hand, cows are so highly bred that it would hardly be a surprise if they had lost the ability to protect themselves from natural predators. That's a topic ripe for rumination by a suitably interested PhD student.

Either way, the new field of cow dynamics looks ready for milking (cough).

Ref: arxiv.org/abs/1005.1381: A Mathematical Model For The Dynamics And Synchronization Of Cows

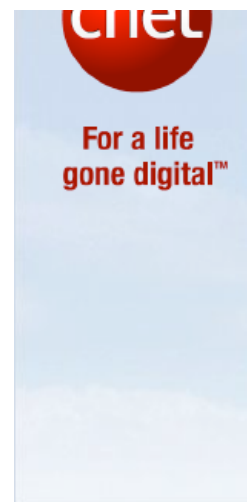
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