

Letters

■ Editor:

"Fronti Nulla Fides": No reliance can be placed on appearance.

In a letter to the editor (*AI Magazine*, Winter 1989), Benjamin Kuipers criticizes various points made in an earlier paper of ours (Akman and ten Hagen 1989).

First, a side (nonetheless important) remark: Although Kuipers asserts that he distributes QSIM to interested researchers, our experience has been otherwise. Akman has tried twice to obtain QSIM, without success. Although Kuipers promised to deliver a copy—QSIM was under revision at the time of Akman's request (this being as early as winter 1988)—the program was never sent. So much for the availability of QSIM. . . .

Kuipers' letter is full of sweeping generalizations that are so much against the nature of scientific enterprise. We should also add that we are disappointed to see Kuipers employing universal truths and unarguable facts such as ". . . if you build the wrong model, the predictions derived from that model are likely to be wrong" or ". . . guarantees of mathematical validity [are] necessary for any science" as his main *cheval de bataille*. In the following we'll point out, one by one, the weaknesses of QSIM. Our task will be easy since we shall merely reproduce, almost verbatim, Kuipers' own sentences (Kuipers 1986) and, additionally, Janowski's (1987) views. (The latter reference gives an excellent review of QSIM's disadvantages.) Then, we'll let the reader judge.

. . . the QSIM algorithm, and local qualitative simulation algorithms in general, cannot be guaranteed against producing spurious behaviors; behaviors which are not actual behaviors for any physical system satisfying the constraint equations [Kuipers' italics] (Kuipers 1986, pp. 317–318).

. . . if a valid description of the mechanism can produce invalid predictions (false positives), *its use-*

fulness is limited [our italics] (Kuipers 1986, p. 318).

If we explicitly add the constraints representing conservation of energy to the oscillating spring constraint equations, the single correct behavior is found. However, although the additional constraints are derivable from the original equations, *it is not at all clear how to do such a derivation automatically for an arbitrary mechanism* [our italics] (Kuipers 1986, p. 321).

If qualitative simulation yields several possible behaviors, *further analysis is required* before concluding that they represent possible futures [our italics] (Kuipers 1986, p. 321).

QSIM is just such a method of fitting together the jigsaw of the histories of individual parameters, *by constraint propagation*, in order to derive the possible behaviors of a system [our italics] (Janowski 1987, p. 67).

For example, it is possible to simulate the behavior of an oscillating spring. But without information about dissipation of energy, QSIM is *unable to tell* whether each successive oscillation is greater, smaller, or the same as the previous one. Accordingly, it generates all three possible behaviors. Obviously, only the decreasing oscillations represent a real-world behavior, and the others are spurious. This illustrates an important point about QSIM: if it is given a correct description of the real-world, then all real-world behaviors of the system will be simulated, but *not all the simulated behaviors will necessarily be possible in the system* [our italics] (Janowski 1987, p. 69).

It is not the role of QSIM to create the initial model: QSIM is a method of solving the problems *once they have been formulated*. By contrast, [Ken] Forbus, and [Johan] de Kleer and [John Seely]

Brown try to define a "physics," of which generating behavioral descriptions is one part but in which they also *attempt to formalize the translation from the real world to the model* [our italics] (Janowski 1987, p. 70).

Thus, there is a distinction between, on the one hand, a "physics" based on general principles which has formalisms for modeling the real world in a qualitative manner and, on the other hand, a tool for "hand-crafting" such models more or less individually. *It is in the second camp that QSIM sits* [our italics] (Janowski 1987, p. 70).

We agree that QSIM is a mathematical language for expressing models, rather than a physical methodology for building correct models. However, this doesn't imply, as Kuipers suggests, that a modeling language must be able to express both good and bad models, both true and false models. This is equivalent to saying that all the responsibility for guaranteeing good models (or true models) is delegated to some outside agent (a person?). We then ask, Where is the intelligence of QSIM if one needs such a drastic amount of intervention?

Kuipers' letter also tries to establish a point which sounds plausible to us and probably to many people working in the area; viz., QSIM is a step toward providing the degree of expressive and inferential power necessary for qualitative physics. Yes, but it is one step! To paint a rosy picture around an "all-powerful QSIM" is an attempt at creating a myth and is dangerous. D. McDermott said, "A common idiocy in AI research is to suppose that having identified the shortcomings of Version I of a program is equivalent to having written Version II" (McDermott 1981). The shortcomings of QSIM are not of the kind that can be corrected in a second version. (QSIM's precursor was ENV [Kuipers 1984].)

Finally, as for the simplistic remarks of Kuipers about causality, we suggest

that he take a look at the modern accounts of causation as presented, say, in Shoham (1987).

Probably, it is apt to conclude this discussion on a lighter note. To quote McDermott again, "To say anything good about anyone is beyond the scope of this letter."

Varol Akman

Bilkent University, Ankara

Paul ten Hagen

Center for Mathematics and Computer Science, Amsterdam

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