Reply to:
“Property-Based Software Engineering Measurement”
Horst Zuse

Abstract—Briand, Morasca, and Basili [1] introduce a measurement theoretic approach to software measurement and criticize among others the work of the author, but they misinterpret the work of the author. Zuse does not require additive software (complexity) measures as Briand, Morasca, and Basili state. Zuse uses the concept of the extensive structure in order to show the empirical properties behind software measures. Briand, Morasca, and Basili use the concept of meaningfulness in order to describe scales and that certain scale levels are not excluded by the Weyuker Properties. However, the authors do not consider, that scales and scale types are different things.

Index Terms—Measurement theory, software measurement, software metrics.

1 INTRODUCTION—BRIAND, MORASCA, AND BASILI


Zuse, p. 82, paragraph 4.3

In his article in the Encyclopedia of Software Engineering, [27, pp. 131-165], Zuse applies a measurement-theoretic approach to complexity measures. The focus is on the conditions that should be satisfied by empirical relational systems in order to provide them with additive ratio scale measures. This class of measures is a subset of ratio scale measures, characterized by the additivity property (Theorems 2 and 3 of [27]). Given the set P of flowgraphs and a binary operation * between flowgraphs (e.g., concatenation), additive ratio scale complexity measures are such that, for each pair of flowgraphs P1, P2,

Complexity (P1 * P2) = Complexity (P1) + Complexity (P2)

This property shows that a different concept of complexity is defined by Zuse, with respect to that defined by Weyuker’s (W9) and our properties (Complexity 4). It is our belief that, by requiring that complexity measures be additive, important aspects of complexity may not be fully captured, and complexity measures actually become quite similar to size measures. Considering complexity as additive means that, when two modules are put together to form a new system, no additional dependencies between the elements of the modules should be taken into account in the computation of the system complexity. We believe this is a very questionable assumption for product complexity [28].

Reply by H. Zuse, p. 82, paragraph 4.3

This is a misinterpretation of my approach. Complexity measures should not always be additive. I say, that measures which are additive with respect to a concatenation operation, assume an extensive structure. However, there exist also many nonadditive measures which assume an extensive structure. In Zuse [2], p. 151, Zuse and Bollmann-Sdorra [3], and Zuse [4] it is shown, that the Measure MCC = V = |E| - |N| + 2 of McCabe is not additive for a sequential concatenation operation, but it also assumes an extensive structure (another example is the Measure PATH (p. 200)). I discuss axioms. I do not say that such axioms have to be fulfilled in reality. I discuss the extensive structure, not because I believe that the axioms hold, but because they are important in order to understand the properties of measures. As a matter of fact many measures assume an extensive structure. If we have reasons to believe that some of the axioms do not hold, then this has consequences for software measurement. For example, if monotonicity does not hold then replacing in a program one component by a less complex one does not imply that the overall complexity decreases. This is an important problem. Also if monotonicity or commutativity do not hold, then all measures that assume this, have to be rejected, for example the Measure of McCabe and LOC.

Briand, Morasca, and Basili write, p. 78, paragraph 3.5

Properties Complexity 1–Complexity 5 hold when applying the admissible transformation of the ratio scale. Therefore, there is no contradiction between our concept of complexity and the definition of complexity measures on a ratio scale.

It is a widely spread misview that showing the meaningfulness of a statement also shows the scale type of a measure. For example, the axiom of weak commutativity ist defined as: u(P1 o P2) = u(P2 o P1) for all P1, P2 ∈ P, where P is, for example, a set of flowgraphs. This statement is meaningful for the ratio scale. But, it is meaningful for the nominal scale too. Every statement is meaningful for the absolute scale. Here scale types and scales are confused. Saying, that a statement is meaningful for a ratio scale has nothing to do with saying: the measure u can be used as a ratio scale. Scale types are defined by admissible transformations, scales are defined by a homomorphism that includes axiom systems.

Measurement Theory, p. 79, paragraph 3.6

On p. 79, paragraph 3.6, Briand, Morasca, and Basili [1] introduce measurement theory. They introduce correctly the empirical and numerical relational systems, but they do not define the homomorphism, that connects both relational systems. The homomorphism is the central idea of measurement and leads to the definition of scales (not scale types).

REFERENCES


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