

ABSTRACT

A PROCEDURE OF IMPLICATION USING QUANTIFIABLE BINARY RELATION ON THE STRUCTURAL MODELING

Eiichiro Yagi Kazuho Yosimoto
Waseda University

In the field of system engineering, numerous attempts have been made by scholars to propose for structural modeling. In the many structural modeling methods, the first process of structural modeling is to make binary relation matrix by a modeler. This process is difficult for modeler because the number of questions to extract binary relation is $n(n-1)$; where n is the number of elements. Structural modeling can be divided into two types. One has 1-0 type of binary relation. Another has quantifiable, more general, binary relation. In the former, this process is doing the procedure that, to suppose the relation has transitive property, it infers the unknown binary relation using transitive property. But, the latter has never such procedure in this process. So we propose the procedure in this paper. The proposed procedure based on the same idea as the former. To suppose the binary relation has transitive property in quantification, it infers the unknown binary relation using this property.

In this paper, the quantifiable binary relation is represented by rank scale. The set of system elements is $S = \{s_i \mid 1 \leq i \leq n\}$ (n is the number of system elements). 's_i has R relation to s_j' shows $s_i R s_j$. Finite ordinal set $I = \{0, 1, \cdots, w\}$, $r : R \rightarrow I$, $r(s_i, s_j)$ means quantifiable binary relation for all $(s_i, s_j) \in S$. The binary relation must have 'reflexive property' and 'transitive property' like reflexiveness and transitiveness. The reflexive property is $r(s_i, s_j) = w$. The transitive property is $r(s_i, s_j) \geq \max_{1 \leq k \leq n} \min\{r(s_i, s_k), r(s_i, s_j)\}$. The procedure is based on 1-1 implication, 1-0 implication, 0-0 implication in 1-0 type. Let us denoted $M = [m_{ij} = r(s_i, s_j)]$ by quantifiable binary relation matrix. m_{ij} divided into $m_{lij} (1 \leq l \leq w)$ by defining m_{lij} as 1 if $m_{ij} \leq l, 0$ if $m_{ij} > l$, and x others. M divided M_l as same. If m_{ij} is extract, m_{ij} divided m_{lij}, and do 3 implication on each M_l. If 0 occur on m_{kij}, do $m_{lij} = 0 (l > k)$.

This algorithm requires $O(wn^2)$ time. In this algorithm, if $w = 1$ we can apply 1-0 type binary relation. We can make quantifiable structural model easily using this algorithm, so it is easy to apply structural modeling.