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Inverse P-information Law Models and The Reality-camouflage Intelligent Transformations of Information Image

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***Abstract*—By improving function inverse P-sets, inverse P-information law model and its structures are proposed. Then attribute disjunctive expansion-contraction generations of inverse P-information law models are presented. Furthermore, inverse P-information reasoning and reasoning structures are proposed Finally intelligent generating theorems of information law are proposed, the reality-camouflage intelligent transformations of information image and their intelligent generations and applications are also given.**

Keywords— inverse P-information law ; function inverse P-set; attribute disjunction; inverse P-information law reasoning

I. INTRODUCTION

Function inverse P-sets [1,2], namely function inverse packet sets, are theoretical models obtained by improving inverse P-sets [3,4]. Function inverse P-set is a set pair, denoted by $(\overline{S}^F, \overline{S}^{\overline{F}})$, it is composed by function internal function internal inverse packet set $\overline{S}^F$ function outer inverse packet set $\overline{S}^{\overline{F}}$. $\forall s_i \in \overline{S}^F$ and $\forall s_j \in \overline{S}^{\overline{F}}$, s_i and s_j are functions, the attribute α_i of $s_i \in \overline{S}^F$ or the attribute α_j of $s_j \in \overline{S}^{\overline{F}}$ satisfies attribute disjunctive normal form. In this article, function $s_i \in \overline{S}^F$ or $s_j \in \overline{S}^{\overline{F}}$ is defined as information law $\overline{w}(x)_i$ or $\overline{w}(x)_j$. The main tasks of this paper are as follows: By improving function inverse P-set, proposes inverse P-information law models, and gives the expansion-contraction relationships between inverse P-information law and its attribute disjunction normal form; proposes inverse P-information law reasoning; gives the intelligent generation theorems of information law ; gives the reality-camouflage intelligent transformations of information image and its applications.

For the convenience of discussion, the concepts of function inverse P-sets are introduced in section 2 as the preparation.

II. FUNCTION INVERSE P-SETS AND THEIR ATTRIBUTE DISJUNCTIVE CHARACTERISTICS [1, 2]

Given finite ordinary function set $S = \{s_1, s_2, \cdots, s_q\} \subset U$, and its attribute set $\alpha = \{\alpha_1, \alpha_2, \cdots \alpha_k\} \subset V$. $\overline{S}^F$ is called function internal inverse packet set generated by *S*, or internal inverse P-set for short, moreover,

$$\overline{S}^F = S \bigcup S^+ \tag{1}$$

Where in (1) $S^+ = \{u_i \mid u_i \in U, u_i \overline{\in} S, f(u_i) = s_i' \in S, f \in F\}$, if the attribute set α^F of $\overline{S}^F$ satisfies

$$\alpha^F = \alpha \bigcup \{\alpha_i' \mid f(\beta_i) = \alpha_i' \in \alpha, f \in F\} \tag{2}$$

$\overline{S}^{\overline{F}}$ is called the outer inverse packet set of *S*, or called function outer inverse P-set for short, moreover,

$$\overline{S}^{\overline{F}} = S - S^- \tag{3}$$

Where in (3), $S^- = \{s_i \mid s_i \in S, \overline{f}(s_i) = u_i \overline{\in} S, \overline{f} \in \overline{F}\}$, if the attribute set $\alpha^{\overline{F}}$ of $\overline{S}^{\overline{F}}$ satisfies

$$\alpha^{\overline{F}} = \alpha - \{\beta_i \mid \overline{f}(\alpha_i) = \beta_i \overline{\in} \alpha, \overline{f} \in \overline{F}\} \tag{4}$$

Where the meanings of $F, \overline{F}, f, \overline{f}$ can be found in Ref.[1,2].

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The set pair $(\overline{S}^F, \overline{S}^{\overline{F}})$ composed by $\overline{S}^F$ and $\overline{S}^{\overline{F}}$ is the function inverse P-set generated by *S*. Set $\{(\overline{S}_i^F, \overline{S}_j^{\overline{F}}) \mid i \in I, j \in J\}$ is the function inverse P-set family.

Attribute disjunctive normal form characteristics of Function inverse P-sets

Given finite ordinary function set $S = \{s_1, \cdots, s_q\}$, $\alpha = \{\alpha_1, \cdots, \alpha_p, \alpha_{p+1}, \cdots, \alpha_q\}$ is the attribute set of *S*, for $\forall s_\lambda \in S$, the attribute α_λ of s_λ satisfies attribute disjunctive normal form $\alpha_\lambda = \alpha_1 \vee \alpha_2 \vee \cdots \vee \alpha_q$.

If attributes $\alpha_{q+1}, \cdots, \alpha_r$ are supplemented into α, then α becomes $\alpha^F = \alpha \bigcup \{\alpha_{q+1}, \cdots, \alpha_r\} = \{\alpha_1, \cdots, \alpha_r\}$, $S = \{s_1, \cdots, s_q\}$ becomes $\overline{S}^F = S \bigcup \{s_{q+1}, \cdots, s_r\} = \{s_1, \cdots, s_r\}$, for $\forall s_i \in \overline{S}^F$, the attribute α_i of s_i satisfies attribute disjunctive normal form as follow:

$$\begin{aligned}\alpha_i &= \left(\alpha_1 \vee \cdots \vee \alpha_q\right) \vee \alpha_{q+1} \vee \cdots \vee \alpha_r \\ &= \alpha_1 \vee \alpha_2 \vee \cdots \vee \alpha_r\end{aligned}$$

If attributes $\alpha_{p+1}, \alpha_{p+2}, \cdots, \alpha_q$ are deleted from α, then α becomes $\alpha^{\overline{F}} = \alpha - \{\alpha_{p+1}, \cdots, \alpha_q\} = \{\alpha_1, \cdots, \alpha_p\}$, $S = \{s_1, \cdots, s_p, s_{p+1}, \cdots, s_q\}$ becomes $\overline{S}^{\overline{F}} = S - \{s_{p+1}, \cdots, s_q\} = \{s_1, \cdots, s_p\}$, for $\forall s_j \in \overline{S}^{\overline{F}}$, the attribute α_j of s_j satisfies attribute disjunctive normal form

$$\begin{aligned}\alpha_j &= (\alpha_1 \vee \cdots \vee \alpha_p \vee \alpha_{p+1} \vee \cdots \vee \alpha_q) - (\alpha_{p+1} \vee \cdots \vee \alpha_q) \\ &= \alpha_1 \vee \alpha_2 \vee \cdots \vee \alpha_p.\end{aligned}$$

Assumption: In following sections, $S = \{s_1, \cdots, s_p\}$, $\overline{S}^F = \{s_1, \cdots, s_r\}$, and $\overline{S}^{\overline{F}} = \{s_1, \cdots, s_p\}$ are denoted by $w_\circ(x) = \{w(x)_1, \cdots, w(x)_q\}$, $\overline{w}_\circ(x)^F = \{w(x)_1, \cdots, w(x)_r\}$, and $\overline{w}_\circ(x)^{\overline{F}} = \{w(x)_1, \cdots, w(x)_p\}$ respectively, $p < q < r$.

III. Inverse P-information law and its attribute disjunction expansion-contraction relationships

Definition 1 Given $W_\circ(x) = \{w(x)_1, \cdots, w(x)_q\}$, $\alpha = \{\alpha_1, \cdots \alpha_q\}$ is the attribute set of $W_\circ(x)$, function $w(x)$ is called information law generated by $W_\circ(x)$, moreover

$$\begin{aligned}w(x) = \oplus_{i=1}^q w(x)_i &= \sum_{i=1}^n y_j \prod_{\substack{i=1 \\ i \neq j}}^n \frac{x - x_i}{x_j - x_i} \\ &= a_{n-1}x^{n-1} + a_{n-2}x^{n-2} + \cdots + a_1 x + a_0,\end{aligned} \tag{5}$$

Where $w(x) = \oplus_{i=1}^q w(x)_i$ denotes the composite of $w(x)_1, w(x)_2, \cdots, w(x)_q$, it is obtained by Lagrange interpolation on $(x_1, y_1), (x_2, y_2), \cdots, (x_n, y_n)$.

Suppose $\{y_{i,1}, y_{i,2}, \cdots, y_{i,n}\}$ is discrete value set formed by the discrete values of $w(x)_i \in W_\circ(x)$, $i = 1, 2, \cdots, q$. $\boldsymbol{y} = (y_1, y_2, \cdots, y_n) = \left(\sum_{i=1}^q y_{i,1}, \sum_{i=1}^q y_{i,2}, \cdots, \sum_{i=1}^q y_{i,n}\right)$ is the discrete value vector of $w(x)$, $(x_1, y_1), (x_2, y_2), \cdots, (x_n, y_n)$ are obtained by $\boldsymbol{y}$.

Definition 2 Given $\overline{W}_\circ(x)^F = \{w(x)_1, \cdots, w(x)_r\}$, α^F is attribute set of $\overline{W}_\circ(x)^F$, function $\overline{w}(x)^F$ is called internal inverse P-information law of $\overline{W}_\circ(x)^F$, moreover

$$\begin{aligned}\overline{w}(x)^F &= \oplus_{i=1}^r w(x)_i \\ &= b_{n-1}x^{n-1} + b_{n-2}x^{n-2} + \cdots + b_1 x + b_0,\end{aligned} \tag{6}$$

if (6) is obtained by (5) on data points (x_1, y_1^f), $(x_2, y_2^f), \cdots, (x_n, y_n^f)$.

Where $(x_1, y_1^f), (x_2, y_2^f), \cdots, (x_n, y_n^f)$ are the data points generated by the discrete value vector $\boldsymbol{y}^F = (y_1^f, y_2^f, \cdots, y_n^f) = \left(\sum_{i=1}^r y_{i,1}, \sum_{i=1}^r y_{i,2}, \cdots, \sum_{i=1}^r y_{i,n}\right)$ of $\overline{W}_\circ(x)^F$; α^F satisfies (2).

Definition 3 Given $\overline{W}_\circ(x)^{\overline{F}} = \{w(x)_1, \cdots, w(x)_p\}$, $\alpha^{\overline{F}}$ is the attribute set of $\overline{W}_\circ(x)^{\overline{F}}$, function $\overline{w}(x)^{\overline{F}}$ is called outer inverse P-information law of $\overline{W}_\circ(x)^{\overline{F}}$, moreover

$$\begin{aligned}\overline{w}(x)^{\overline{F}} &= \oplus_{i=1}^p w(x)_i \\ &= c_{n-1}x^{n-1} + c_{n-2}x^{n-2} + \cdots + c_1 x + c_0\end{aligned} \tag{7}$$

if (7) is obtained by using (5) on data points $(x_1, y_1^{\overline{f}}), (x_2, y_2^{\overline{f}}), \cdots, (x_n, y_n^{\overline{f}})$. Where $(x_1, y_1^{\overline{f}}), (x_2, y_2^{\overline{f}}), \cdots, (x_n, y_n^{\overline{f}})$ are the data points generated by the discrete value vector $y^{\overline{F}} = (y_1^{\overline{f}}, \cdots, y_n^{\overline{f}}) = \left(\sum_{i=1}^p y_{i,1}, \cdots, \sum_{i=1}^p y_{i,n}\right)$ of $\overline{W}_\circ(x)^{\overline{F}}$; $\alpha^{\overline{F}}$ satisfies (4).

Definition 4 The information law pair $(\overline{w}(x)^F, \overline{w}(x)^{\overline{F}})$, composed by $\overline{w}(x)^F$ and $\overline{w}(x)^{\overline{F}}$, is called inverse P-information law; Set $\{(\overline{w}(x)_i^F, \overline{w}(x)_j^{\overline{F}}) \mid i \in I, j \in J\}$ is called the inverse P-information law family generated by $W_\circ(x)$.

Proposition 3 $w(x) - \overline{w}(x)^F \le 0$; $w(x) - \overline{w}(x)^{\overline{F}} \ge 0$.

Proposition 4 $W_\circ(x)$ can generates multiple inverse P-information laws in the form of $(\overline{w}(x)^F, \overline{w}(x)^{\overline{F}})$ which constitute set $\{(\overline{w}(x)_i^F, \overline{w}(x)_j^{\overline{F}}) \mid i \in I, j \in J\}$.