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An Approach for the Formation of Informative Attributes Sets for Magnetic Disk Packs

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Introduction

Generally speaking, an informative attribute is every characteristics for a given event, phenomenon or object which contains at least some minimal information. Hence, the number of attributes in a set describing (for example) one object is, theoretically and practically, very large. That is why, the purpose to form subsets with the least possible attributes number, describing the subject well enough, is logical and reasonable. It is established that the subsets facilitate the evaluation and the selection of objects and improve their classification [1, 2].

Each informative attribute contains a certain amount of information with a definite value. In case these criteria of the attributes, their quality and value are known, it is not difficult to arrange them with respect to the quality and value of the information they include.

Unfortunately, when the objets are not well known or not treated from an informative point of view, the computing of the quality and the value of the attributes information is very difficult, sometimes even impossible. In this case specific methods are designed, sometimes appliable for a limited number of objects only.

The method of the main components is comparatively widely used. A subset with decreased number of terms [3] is formed in it from the possibly fullest set of attributes with the help of a linear transformation.

The method of correlation pleiads [4] is widely used for new objects of investigation. Its essence is in the formation of pleiads (groups) of attributes with a large correlation ratio within a given pleiad and a comparatively small correlation ratio with the attributes from the other pleiads. After that one or several representatives are chosen from each pleiad to form the subsets.

Each group encloses the so called methods with sequential choice, described in details by Kettler [5].

In two of them the so called "Sequential forward selection" and "Generalized sequential forward selection" are used, starting from an "empty subset". The attribute

carrying most information is stored in it, after that this attribute, that forms the best pair with the first one, after that the third, that forms the best triple with the first two and so on, until the corresponding subset is formed.

In the other two methods, called "Sequentional backward selection" and "Generalized sequential backward selection", the fullest attributes set is taken as an outset. The attribute with the least information is excluded from it, after that the one with the least information in comparison with the remaining ones and so on, until the extremum of the quality functional is reached.

A typical disadvantage of these methods is that the included or excluded attributes cannot be included or excluded, respectively, in and from the subset. This is avoided in the methods with "Sequential forward floating selection" and "Sequential backward floating selection", described by P u d i l et a l. [6]. These two methods enable the multiple inclusion or exclusion of one and the same attribute when forming the desired subset.

Purpose of the study

There are not any data in literature about the formation of sets or subsets of informative attributes on information carriers.

The purpose of the present paper is to develop and suggest a method for the formation of sets and subsets of informative attributes for magnetic disk information carriers.

An approach for the formation of subsets for magnetic information carriers

The methods above mentioned in their original form are not appliable for the solution of the problem set. Its specificity has implied the creation of a particular method using the formulations of two or more methods on the basis of an expert evaluation of the attributes correlation and linearity.

The method is characterized by the following sequence in the formation of one subset.

1. Formation of the possibly fullest set of informative attributes for a given object.

2. Formation of the possibly least number of pleiads of attributes on the basis of an expert evaluation of the correlation.

3. Selection of one or more attributes of the subset from each pleiad on the basis of an expert evaluation.

4. Formation by an expert evaluation of a new attribute or attributes for those pleiads, from which a representative subset cannot be selected.

5. Formation of a subset of chosen and newly formed attributes.

6. Excluding or including of new attributes from the subset already formed.

Having in mind the assumption that the linear transformation and the correlation among the attributes are done on the basis of an expert evaluation, it can be accepted that the basic statements of the main components method, the methods of pleiads and the floating selection have been applied in the method proposed.

Formation of a subset of informative attributes for a single magnetic disk

The applicability of the method suggested is illustrated well by the object "single

magnetic disk" (SMD), the simplest in construction disk magnetic carrier.

The single magnetic disk is a circular substrate with an opening in the middle, on both sides of which the following layers are put and sequentially processed: anti-corrosion layer, magnetic layer, hard protective layer and lubricating layer.

When forming the subset of this representative of the magnetic information carriers, the sequence above mentioned will be regarded.

1. Formation of the possibly fullest set of informative attributes of the single magnetic disk

It comprises all the characteristics of the single magnetic disk, including those of the substrate and the coatings and layers on it. Since these characteristics are included in the pleiads below given, they will not be mentioned here.

2. Pleiads formation

The informative attributes of a single magnetic disk can be separated into eleven pleiads on the basis of an expert evaluation.

First pleiad

1. Type of the substrate (S)
2. Composition of the substrate material.
3. Linear expansion of the S.
4. S weight

Second pleiad

1. External diameter D1 of the SMD
2. Internal diameter D2 of the SMD
3. Concentricity of the diameters
4. SMD thickness
5. Chamfer of the external diameter
6. Chamfer of the internal diameter

Note: D1 and D2 are the maximal sizes of SMD diameters

Third pleiad

1. Type of the anti-corrosion coating (ACC) of the substrate.
2. ACC composition
3. ACC thickness
4. Adhesion of the ACC to the substrate.
5. Adhesion of the ACC to the magnetic layer
6. ACC resistance to atmosphere conditions
7. Class of ACC roughness
8. Wear resistance of ACC

Fourth pleiad

1. Type of the magnetic layer (ML)
2. ML thickness
3. Coercive force of the ML
4. Induction of saturation in ML
5. Residual induction of the ML.
6. Rectangularity of ML hystheresis
7. ML peakshift
8. ML location
9. ML composition
10. Corrosion resistance of the ML
11. Adhesion of the ML to the substrate
12. ML wear resistance
13. Class of ML roughness

Fifth pleiad
1. Type of the protective layer (PL) of the ML
2. Composition of the (PL)
3. PL thickness
4. Adhesion of the PL towards the ML
5. Wear resistance of the PL
6. Corrosion resistance of the PL

Sixth pleiad
1. Type of the lubricating layer (LL) of SMD
2. LL composition
3. LL thickness
4. LL static coefficient of friction
5. LL dynamic coefficient of friction
6. Wear resistance of the LL

Seventh pleiad
1. Inertia moment of SMD
2. Radial beat of SMD
3. Axial beat of SMD
4. Speed of SMD axial beat
5. Acceleration of SMD axial beat
6. Stability of SMD at high revolutions

Eighth pleiad
1. Maximal linear recording density of SMD
2. Maximal radial recording density of SMD
3. Number of tracks on one surface of the SMD
4. Maximal storage density on one surface unit.
5. SMD capacity

Note: The maximal recording densities are determined by the storage devices, for which SMD are intended.

Ninth pleiad
1. Amplitude of the signal read on the external working diameter (Dr1)
2. Amplitude of the signal read on the internal working diameter (Dr2)
3. Resolution of Dr1 of the SMD
4. Resolution of Dr2 of the SMD
5. Re-writing of Dr1 on SMD
6. Re-writing of Dr2 on SMD
7. Modulation of the signal of Dr1 on SMD
8. Modulation of the signal of Dr1 on SMD
9. Number of errors on one surface of SMD
10. Number of errors on both surfaces of SMD
11. Number of "missing bit" errors
12. Number of "extra bit" errors
14. Reliability

Note: Dr1 and Dr2 are the external and internal working diameters of ML.

Tenth pleiad
1. SMD resistance to continuous functioning
2. SMD resistance to vibrations
3. SMD resistance to strokes
4. SMD resistance to large and sharp accelerations
5. SMD resistance to large and sharp delays
6. SMD resistance to multiple landing on and off of the magnetic heads

Eleventh pleiad

1. Maximal working temperature of SMD
2. Minimal working temperature of SMD.
3. Maximal relative humidity of SMD functioning
4. Maximal temperature of SMD transport
5. Minimal temperature of SMD transport
6. Maximal relative humidity of SMD transport
7. Maximal temperature of SMD storing
8. Minimal temperature of SMD storing
9. Maximal relative humidity of SMD storing

3. Selection of one or more attributes from each pleiad

Most of the pleiads formed have at least one attribute that contains enough information for it. These are:

I pleiad – Type of the substrate (S) material
III pleiad – Type of the anti-corrosion coating of the substrate
IV pleiad – Type of the magnetic layer (ML)
V pleiad – Type of the protective layer of the ML
VI pleiad – Type of the lubricating layer of SMD
VIII pleiad – SMD capacity
IX pleiad – reliability (number of errors) on SMD

4. Formation of new attributes

New attributes have been formed for the remaining four pleiads by an expert estimate.

II pleiad – SMD geometry
VII pleiad – SMD dynamic parameters
X pleiad – SMD stability to external mechanic influences
XI pleiad – Climatic conditions of exploitation, transport and storing of SMD

5. Formation of the finite subset of attributes for SMD

The selected and newly formed attributes are included in it.

1. Type of the substrate material
2. SMD geometry
3. Type of S anti-corrosion plating
4. Type of the magnetic layer
5. Type of ML protective layer
6. Lubricating layer of SMD
7. SMD dynamic parameters
8. SMD capacity
9. Reliability (errors number) of SMD
10. SMD resistance towards external mechanical influences
11. Climatic conditions of exploitation, transport and storing of SMD

6. Excluding attributes from the subset formed

The attributes included in the subset describe well enough the SMD. Nevertheless half of them have a technological character and hence the SMD producers are not likely to discover them. That is why for commercial and advertisement materials only those attributes are selected that do not contain technological information but describe satisfactorily the carrier and are of interest for the user also.

In the case considered these are the following attributes:

1. Disk geometry;
2. SMD capacity;

3. Type of the ML - type of the layer;
4. Reliability, for example errors number (most often a disk without errors);
5. Climatic conditions of exploitation, transport and storing.

Conclusion

The example with the single magnetic disk illustrates successfully the possibilities and necessity for application of the method suggested in scientific research and applied projects and for commercial purposes as well - for example in printing brochures about the product, not revealing any technological information.

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Подход формирования подмножества информативных признаков для магнитных дисковых пакетов

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(Резюме)

В литературе нет данных о подходе и методе формирования подмножества информативных признаков для информационных носителей.

В работе предлагается подход и метод формирования подмножества этих объектов. Применение метода иллюстрированно для случая единичного магнитного диска.