

Chapter 7.17

A Static Web Immune System and its Robustness Analysis

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ABSTRACT

Static Web immune system is an important application of artificial immune system, and it is also a good platform to develop new immune computing techniques. On the Static Web system, a normal model is proposed with the space property and the time property of each component, in order to identify the normal state of the system that the artificial immune system protects. Based on the normal model, the Static Web immune system is modelled with three tiers, that is the innate immune tier, the adaptive immune tier and the parallel immune tier. All the three tiers are inspired from the natural immune system. On the tri-tier immune model, the self detection mechanism is proposed and programmed based

on the normal model, and the non-self detection is based on the self detection. Besides, the recognition of known non-selfs and unknown non-selfs are designed and analyzed. It is showed that the Static Web immune system is effective and useful for both theory and applications.

A.1 INTRODUCTION

Human immune system is very important for human health, because it is able to detect, recognize, memorize and eliminate foreign viruses and inner faults, which are sometimes unknown and even quite complex (Perelson, Hightower & Forrest, 1996; Fauci, 2003; Chao, Davenport & Forrest, et al, 2004). Inspired from nature, artificial immune system is very important for computer world,

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because it is used to detect, recognize, learn, memorize and eliminate special objects, which are possibly unknown and even quite complex, such as computer viruses, faults and so on (De Castro & Timmis, 2002; Jerne, 1974; De Castro & Von Zuben, 2002). However, due to incomplete theories of immunology, one of bottlenecks for detecting the unknown non-selfs prevents the artificial immune system from developing. First, traditional detection approaches against viruses and faults are based on matching the features of the viruses and faults, and the features of unknown viruses and unknown faults are possibly unknown, thus 100% detection is impossible in theory (Balachandran, 2005; Gonzalez & Dasgupta, 2003). Second, the faulty mechanism for detecting viruses and faults causes lower possibility for recognizing the viruses and faults, and affects ability and efficiency for repairing the damaged computer system. To overcome the bottleneck of research on the artificial immune system and improve research on the basis of the anti-worm application and software fault diagnosis, a normal model of the static web immune system is proposed and built with the space-time properties of the components, and the normal model is used to represent the selfs.

A.2 BACKGROUND

Web system is popular on the Internet now and useful for many web users, and web security has become a serious problem due to viruses, worms and faults (Balthrop, Forrest & Newman, et al., 2004; Orman, 2003). To solve the security problem, some detecting techniques are used to recognize the non-selfs such as viruses and faults by matching the features of the non-selfs, but the traditional techniques have a difficult bottleneck in detecting unknown non-selfs especially such as brand-new viruses. To overcome the bottleneck, a new strategy for detecting the unknown non-selfs has been proposed with the normal model of the system that the artificial immune system

protects. Current work has been done on the static web system and in fact many static web systems are useful and popular on the Internet, such as the webpage system for many companies and universities.

A.2.1 Space Property of Component

Suppose a static web system S is comprised of m web directories and n files in the cyberspace, and the system can be represented with the set

$$\{p_{ij}, d_k, \sum_{i=1}^m n_i = n; p_{ij} \in S; j = 1, \dots, n; k = 1, \dots, m\}$$

Here, p_{ij} denotes the j th file in the i th directory of the system S , d_k denotes the k th directory in the system S , and n_i denotes the sum of all files in the i th directory of the system S .

The components of the static web system are software parts, and the software is used to simulate the physical world in the cyberspace. In the physical world, every object has unique 3-dimension space coordinates and 1-dimension time coordinate, so that the state of the object is uniquely identified by its space-time coordinates (Einstein, 1920). Alike in the cyberspace, every software part has unique location for storing the space property because the storage of the software is based on the hardware in the physical world. The absolute pathname p_i is used to represent the location information for storing the file and/or the directory, and the pathname consists of the name r_i of the disk or the URL, the name d_i of the directory and the full name n_i of the file c_i , shown in Figure 1. The full name of the file includes the file-name of the file and the suffix name of the file, and the suffix name of the file is one of features that are useful for classifying the files.

According to the basic rules of the operating systems for managing the files, the absolute pathname of the file c_i uniquely identifies the location

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