

## Chapter 22

# New Perspectives of Pattern Recognition for Automatic Credit Card Fraud Detection

**Addisson Salazar**

*Universitat Politècnica de València, Spain*

**Gonzalo Safont**

*Universitat Politècnica de València, Spain*

**Alberto Rodriguez**

*Universidad Miguel Hernández de Elche, Spain*

**Luis Vergara**

*Universitat Politècnica de València, Spain*

### **ABSTRACT**

*Automatic credit card fraud detection (ACCFD) is a challenge issue that has been increasingly studied considering the expanded potential of new technologies to emulate legitimate operations. Solution has to handle changing fraud behavior, detection in data with very small fraud/legitimate operations ratio, and accomplish operation requirements of very low false alarm in real-time processing. In this chapter, main issues related with the problem of ACCFD and proposed solutions are discussed from theoretical and practical standpoints. The perspective of detection analyses from receiving operating characteristic curves and business key performance indicators are jointly analyzed. A new conceptual framework for ACCFD considering decision fusion and surrogate data is outlined including a case of study with different proportions of real and surrogate data. In addition, the sensitivity of the methods to different proportions of fraud/legitimate ratios is tested. Finally, theoretical and practical conclusions are provided, and several open lines of research are proposed.*

DOI: 10.4018/978-1-5225-7492-7.ch022

## INTRODUCTION

The automatic detection of frauds in financial operations using credit cards is a challenge issue that has been increasingly studied. The rapid expansion of information and communication technologies has expanded the potential to emulate legitimate operations by fraudsters. The solution to that problem has to be able to be adaptive since the behavior of frauds is changing constantly in time; to handle the detection in data with a very small ratio of fraud amount to legitimate operations, e.g.,  $5e-5$ ; and accomplish operation requirements of very low false alarm ratios in real-time processing. Thus, several approaches have been proposed from pattern recognition and machine learning areas.

Main issues related with the problem of automatic credit card fraud detection (ACCFD) and proposed solutions are discussed from theoretical and practical standpoints. The perspective of detection analyses from receiving operating characteristic (ROC) curves and business key performance indicators (KPI) are jointly analyzed (Girgenti & Hedley, 2011) (Wells, 2011) (Montague, 2010). Therefore, a new conceptual framework for ACCFD considering modern techniques such as decision fusion and surrogate data is outlined. There are only a few references from the research field of signal processing for ACCFD, see for instance (Salazar, Safont, Soriano, & Vergara, 2012).

A case of study that combines different proportions of real and surrogate data is included. Several scenarios considering different single and combined methods are considered. ROC and KPI curves are analyzed bearing in mind numeric and operational requirements. The sensitivity of the methods to different proportions of fraud/legitimate ratios is tested. Thus, limitations and advantages of the studied methods are demonstrated.

## BACKGROUND

Cyber-security and privacy have become very important subjects of research in recent years. This research spans many different fields, such as: security in the physical layer of wireless communications (Poor, 2012)); database security (Sankar, Rajagopalan, & Poor, 2013); distributed systems (Pawar, El Rouayheb, & Ramchandran, 2011); and biometrics (Lifeng, Ho, & Poor, 2011). One activity where the security and privacy mechanisms are critical is the e-commerce by using credit cards. This application features a massive volume of on-line transactions that are continuously exposed to frauds. Fraud detection in credit card transactions is a critical problem affecting large financial companies and involving annually loss of billions of dollars (Bhattacharyya, Jha, Tharakunnel, & Westland, 2011).

Basically two strategies can be raised. The first consists of defining the problem as one-class classification, and thus, characterizing the largest data population (the legitimate transactions) and considering all the data with different characteristics as outliers (Hodge & Austin, 2004) (Tax & Duin, 2001). The second strategy is to define the problem as a two-class classification characterizing legitimate and fraudulent transaction data. We have concentrated in this later detection approach which takes full advantage of the available labeled data.

There is extensive literature that reviews and provides taxonomies and comparisons about the large number of ACCFD methods that have been developed during the last two decades (e.g., (Danenas, 2015)). However, only few of these references are from the research field of signal processing. The particular characteristics of ACCFD make this a challenging problem for signal processing algorithms (Salazar,

14 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

[www.igi-global.com/chapter/new-perspectives-of-pattern-recognition-for-automatic-credit-card-fraud-detection/213657](http://www.igi-global.com/chapter/new-perspectives-of-pattern-recognition-for-automatic-credit-card-fraud-detection/213657)

## Related Content

---

### How the Nature of Exogenous Shocks and Crises Impact Company Performance?: The Effects of Industry Characteristics

Ji Li, Wei Sun, Wanxing Jiang, He Yang and Ludan Zhang (2017). *International Journal of Risk and Contingency Management* (pp. 40-55).

[www.irma-international.org/article/how-the-nature-of-exogenous-shocks-and-crises-impact-company-performance/188681](http://www.irma-international.org/article/how-the-nature-of-exogenous-shocks-and-crises-impact-company-performance/188681)

### Role of Digital Identity in Advancing Global Health: A 360 Perspective

Indira Mysore (2023). *Digital Identity in the New Era of Personalized Medicine* (pp. 1-27).

[www.irma-international.org/chapter/role-of-digital-identity-in-advancing-global-health/318177](http://www.irma-international.org/chapter/role-of-digital-identity-in-advancing-global-health/318177)

### Scope Reductions as Tool for Cost Control in Construction Projects: An Ex-Post Analysis of Scope Reduction Options

Nils O. E. Olsson (2015). *International Journal of Risk and Contingency Management* (pp. 1-16).

[www.irma-international.org/article/scope-reductions-as-tool-for-cost-control-in-construction-projects/145362](http://www.irma-international.org/article/scope-reductions-as-tool-for-cost-control-in-construction-projects/145362)

### Teaching Case for Addressing Risks with Strategies in an International Airport Project

Daly Paulose (2013). *International Journal of Risk and Contingency Management* (pp. 18-35).

[www.irma-international.org/article/teaching-case-addressing-risks-strategies/76655](http://www.irma-international.org/article/teaching-case-addressing-risks-strategies/76655)

### Architectures for Advanced Cryptographic Systems

Guido Bertoni, Jorge Guajardo and Christof Paar (2008). *Information Security and Ethics: Concepts, Methodologies, Tools, and Applications* (pp. 771-817).

[www.irma-international.org/chapter/architectures-advanced-cryptographic-systems/23127](http://www.irma-international.org/chapter/architectures-advanced-cryptographic-systems/23127)