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Opinion Analysis in Interactions

From Data Mining to Human–Agent Interaction

Chloé Clavel

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Preface

This book is dedicated to the analysis of opinions in human–human and human–agent interactions. We shall present methods based on artificial intelligence (through learning models of socio-emotional behaviors, combining symbolic and machine learning methods) and affective computing (analysis and synthesis of socio-emotional signals).

The work presented here is essentially that which was submitted for my *Habilitation à diriger des recherches* (HDR) on May 29, 2017. It was written from an essentially personal perspective and was not intended to provide exhaustive coverage of the field in question. My vision of the subject evidently bears the marks of my own research career in both academic and industrial settings.

Following my doctoral thesis on acoustic recognition of emotions [CLA 07], I took up a research post in the R&D center at Thales Research and Technology. Later, I extended my field of study from acoustic analysis to natural language processing in the context of opinion analysis studies carried out at EDF Lab.

Since 2013, I have held a teaching and research post at the LTCI (*Laboratoire Traitement et Communication de l'Information*, Information and Communications Processing Laboratory) at Telecom-ParisTech. My current research builds on the work I carried out at EDF Lab on the analysis of opinions and feelings in written and oral interactions, encompassing the treatment of emotions and social attitudes in human–agent interactions. More specifically, my aim is to examine the modes of expression (verbal and

prosodic) in the context of interactions between a human individual and an animated conversation agent, and to support the development of socially and emotionally competent agents.

This book presents the various studies that I have carried out on these subjects, grouped around two main axes:

– opinion analysis in human–human and human–agent interactions;

– socio-emotional interaction strategies and the generation of socio-emotional behaviors in human–agent interactions.

The research presented here is rooted in the fields of natural language processing, applied machine learning, affective computing and social human–machine/human–robot interactions. It was developed within a multidisciplinary context, drawing on fields such as psychology, sociology and linguistics. This multidisciplinary facet is crucial given the nature of the subject, from the expression of opinions to social attitudes.

The majority of the work presented here was carried out by research interns, doctoral and postdoctoral students working under my supervision (listed chronologically):

– interns: Charlotte Danesi, Camille Dutrey, Rachel Bawden and Jessica Durand;

– doctoral students: Rémi Lavalley, Camille Dutrey, Caroline Langlet, Thomas Janssoone, Irina Maslowski and Valentin Barrière;

– postdoctoral students: Sabrina Campano, Guillaume Dubuisson-Duplessis, Brian Ravenet and Atef Ben-Youssef.

This work also draws on the results of collaborative efforts, notably in the context of cosupervision of the doctoral and post doc students named above.

The studies of opinion analysis methods for interactions were carried out in collaboration with Anne-Laure Guénet, Delphine Lagarde, Anne Peradotto and Alina Stoica Beck at EDF, and with Patrice Bellot and Marc El-Béze of the Avignon Informatics Laboratory.

The work on oral data from call centers, notably the disfluence analysis presented in Chapters 1 and 2, is the fruit of a collaboration with the LIMSI-CNRS, the *Laboratoire d'Informatique pour la Mécanique et les Sciences de*

l'Ingénieur (Informatics Laboratory for Mechanics and Engineering Sciences) at the University of Paris 11 (Sophie Rosset and Ioana Vasilescu) and with the LPP, the *Laboratoire de Phonétique et Phonologie* (Phonetics and Phonology laboratory) at Paris 3 (Martine Adda-Decker).

My research on human–agent interactions (presented in Chapters 3, 4 and 5) coincided with my arrival at the LTCI, and benefited hugely from a long and fruitful collaborative partnership with Catherine Pelachaud. The work on conditional random fields presented in Chapter 3 was made possible by expertise provided by the LTCI in the context of a collaboration with Slim Essid; the study of facial expression generation, described in Chapter 5, would not have been possible without the support of Kévin Bailly (ISIR). The prosodic behavior generation and alignment measurement techniques presented in Chapters 4 and 5 owe a good deal to scientific discussions with Frédéric Landragin from Lattice.

Finally, I wish to thank Björn Schuller, Dirk Heylen and Nicolas Sabouret, the reviewers of my HDR assessment, along with Frédéric Bechet, Mohamed Chetouani and Patrick Paroubek, the examiners, for their probing questions and stimulating discussion, which provided inspiration and motivation for my subsequent work.

Chloé CLAVEL
May 2019

Introduction

From Opinion Mining to Human–agent Interactions

The automatic analysis of opinions in interactions is a rapidly expanding domain, encouraged, on the one hand, by the challenges presented by practical applications and, on the other hand, by the growing presence of online platforms for public expression and media. This development offers exciting new possibilities in terms of critical expression and action over the Internet [CAR 13], and the quantity and variety of data available is increasing. In terms of natural language processing, the challenge is to analyze expressions of opinion automatically for the purposes of analyzing social trends. There are many possible applications for these techniques: analyzing citizens' opinions of candidates at election time, analyzing Internet users' opinions of a product (or product reputation), identifying target clients for recommendation systems, evaluating the success of an advertising campaign, etc.

Running parallel to this social web phenomenon, social robotics, and human–agent interactions as a whole, offer fertile ground for the analysis of opinions in interactions between humans and virtual agents. For example, companion robots are used to provide assistance to users (helping maintain independence) and for entertainment purposes. In this context, knowledge of the user and their profile is critical in order to build a social link between the person and the robot. Using this profile (particularly user preferences, in this case), a companion robot may, for example, choose subjects to discuss when interacting with the user, or recommend products, music or entertainment that they may enjoy.

The possible applications of the domain are manifold, as are the challenges it represents. In recent years, virtual agents have come into use for managing client relations on websites, and a number of companies have developed their own virtual assistants (such as Alexa (Amazon), Siri (Apple) and Cortana (Microsoft)). Whilst these virtual assistants are already widely used, further work on the social component of interactions is crucial in order to improve the fluidity and natural feel of interactions. A further area in which socio-emotional behaviors in human–agent interactions may be taken into account is that of Serious Games, in which users may be trained to handle different situations in conjunction with a virtual agent. For example, in [YOU 15], users can work on improving their social behaviors in the context of virtual job interviews.

The research on opinion analysis presented in this work covers two different interaction situations:

1) human–human interactions collected online and from company data;

2) human–agent interactions (embodied conversational agents, robots).

Opinion detection and analysis approaches have been welcomed with open arms by the machine learning community, although the areas of natural language processing and affective computing have sometimes been omitted. In this work, we shall make use of research carried out in all three fields (affective computing, machine learning and natural language processing). We shall present detection methods including logico-semantic rules and machine learning methods, choosing the most appropriate option for different scientific problems and in response to different levels of maturity. Rule- and knowledge-based methods constitute an essential first step in defining the outlines of new scientific problems. For instance, we defined logico-semantic rules to develop an initial user opinion detection system in a context of human–agent interactions, a subject not previously covered in the literature.

Our work focuses on a number of research questions woven through every chapter. In this introduction, we shall establish the scientific context and specific elements of each of these main questions.

– the first research question relates to theoretical opinion models (Q1, presented in section I.1);