

# Identifying Opinion Holders and Targets with Dependency Parser in Chinese News Texts

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## Abstract

In this paper, we propose to identify opinion holders and targets with dependency parser in Chinese news texts, i.e. to identify opinion holders by means of reporting verbs and to identify opinion targets by considering both opinion holders and opinion-bearing words. The experiments with NTCIR-7 MOAT's Chinese test data show that our approach provides better performance than the baselines and most systems reported at NTCIR-7.

## 1 Introduction

In recent years, *sentiment analysis*, which mines opinions from information sources such as news, blogs and product reviews, has drawn much attention in the NLP field (Hatzivassiloglou and McKeown, 1997; Pang et al., 2002; Turney, 2002; Hu and Liu, 2004).

An opinion expressed in a text involves different components, including opinion expression, opinion holder and target (Wilson and Wiebe, 2003). Opinion holder is usually an entity that holds an opinion, and opinion target is what the opinion is about (Kim and Hovy, 2006). Although there have been research on identifying opinion holders and targets in English product reviews and news texts, little work has been reported on similar tasks involving Chinese news texts.

In this study, we investigate how dependency parsing can be used to help the task on opinion holder/target identification in Chinese news texts. Three possible contributions from this study are: 1) we propose that the existence of reporting verbs is a very important feature for identifying opinion holders in news texts, which has not been clearly indicated; 2) we argue that the identification of

opinion targets should not be done alone without considering opinion holders, because opinion holders are much easier to be identified in news texts and the identified holders are quite useful for the identification of the associated targets. Our approach shows encouraging performance on opinion holder/target identification, and the results are much better than the baseline results and most results reported in NTCIR-7 (Seki et al., 2008).

The paper is organized as follows. Sec. 2 introduces related work. Sec. 3 gives the linguistic analysis of opinion holder/target. The proposed approach is described in Sec. 4, followed by the experiments in Sec. 5. Lastly we conclude in Sec. 6.

## 2 Related Work

Although document-level sentiment analysis (Turney, 2002; Pang et al., 2002) can provide the overall polarity of the whole text, it fails to detect the holders and targets of the sentiment in texts.

### 2.1 Opinion Holders/ Target Identification

For opinion mining of product reviews, opinion holder identification is usually omitted under the assumption that opinion holder is the review writer; and opinion targets are limited to the product discussed and its features (Hu and Liu, 2004). But in news texts, opinion holders/targets are more diverse: all named entities and noun phrases can be opinion holders; while opinion targets could be noun phrases, verb phrases or even clauses (Kim and Hovy, 2006; Ruppenhofer et al. 2008).

Bethard et al. (2004) identify opinion propositions and their holders by semantic parsing techniques. Choi et al. (2005) and Kim and Hovy (2005) identify only opinion holders on the MPQA corpus (Wilson and Wiebe, 2003). Kim and Hovy (2006) proposed to map the semantic frames of FrameNet into opinion holder and target for only adjectives and verbs. Kim et al. (2008) proposed to

use syntactic structures for target identification without considering opinion holders. Stoyanov and Cardie (2008) define opinion *topic* and *target* and treat the task as a co-reference resolution problem.

For the identification of opinion holders/targets in Chinese, there were several reports at NTCIR-7 (Seki et al., 2008). Xu et al. (2008) proposed to use some heuristic rules for opinion holder/target identification. Ku et al. (2008) treated opinion holder identification as a binary classification problem of determining if a word was a part of an opinion holder.

## 2.2 Chinese Dependency Parsing

Dependency structures represent all sentence relationships uniformly as typed dependency relations between pairs of words. Some major dependency relations for Chinese (Ma et al., 2004) include 主谓 (Subject-Verb, SBV), 动宾 (Verb-Object, VOB), 定中 (Attributive-Noun, ATT), 数量 (Quantifier, QUN) and 独立结构 (Independent structure, IS). Consider the following Chinese sentence:

a) 俄國 外長 伊凡諾夫 說，北約 東向 擴張是 “ 邁向 錯誤 的方向 ” 。

Russian Foreign Minister Ivanov said that NATO's eastward expansion was "Towards the wrong direction."

Its dependency tree is shown in Figure 1. Its head is the verb 說 (said), whose subject and object are respectively 俄国外长伊凡诺夫 (Russian Foreign Minister Ivanov) and the embedded clause 北約東向擴張是“邁向錯誤的方向” (NATO's eastward expansion was "towards the wrong direction.").

## 3 Linguistic Analysis of Opinions

The opinions in news text may be explicitly mentioned or be expressed indirectly by the types of words and the style of language (Wilson and Wiebe, 2003). Two kinds of lexical clues are exploited here for opinion holder/target identification:

**Reporting verbs:** verbs indicating speech events;

**Opinion-bearing Words:** words or phrases containing polarity (i.e. positive, negative or neutral).

In sentence a) above, the reporting verb 說 (said) indicates a speech event expressing an opinion given by the holder 俄国外长伊凡诺夫 (Russian Foreign Minister Ivanov). Meanwhile, the opinion-

bearing word 錯誤 (wrong) shows negative attitude towards the target 北約東向擴張 (NATO's eastward expansion).

Therefore, we assume that a large proportion of holders are governed by such reporting verbs, while targets are usually governed by opinion-bearing words/phrases.

Opinion holders are usually named entities, including, but not limited to, person names (e.g. 經濟學家歐爾/economist Ol), organization names (e.g. 英國政府/UK government), and personal titles (e.g. 經濟學家/the economist). Opinion holders can also be *common noun phrases*, such as 廠商 (companies), 兩千名學生 (two thousand students). *Pronouns*<sup>1</sup> can also be opinion holders, e.g. 他 (he), 他們 (they), 我 (I). Opinion targets are more abstract and diverse, and could be agents, concrete objects, actions, events or even abstract ideas. In addition to noun phrases, opinion targets could also be *verb phrases* or *embedded clauses*.

## 4 Identifying Opinion Holders/Targets

In this section, we introduce our approach of identifying opinion holders/targets. We use the dependency parser in the HIT LTP package (<http://ir.hit.edu.cn/>) to get the dependency relations of the simplified Chinese sentences converted from the traditional Chinese ones.

### 4.1 Lexical Resources

The reporting verbs were firstly collected from the Chinese sample data of NTCIR-6 OAPT (Seki et al., 2007) in which the *OPINION\_OPR* tag was used to mark them. We then use HowNet, WordNet and Tongyici Cilin to extend the reporting verbs from 68 to 308 words through manual synonym search. Some frequently used reporting verbs include 說 (say), 表示 (express), 認為 (think), etc. Some of the reporting verbs could also convey opinions, such as 批評 (criticize), 譴責 (condemn), 讚揚 (praise), etc.

For opinion-bearing words/phrases, we use *The Lexicon of Chinese Positive Words* (Shi and Zhu, 2006) and *The Lexicon of Chinese Negative Words* (Yang and Zhu, 2006), which consist of 5046 positive items and 3499 negative ones, respectively.

<sup>1</sup> The resolution of the anaphor or co-reference has not been dealt with yet, i.e. the identified holders of the sentence are assumed to be in the same form as it appears in the sentence.

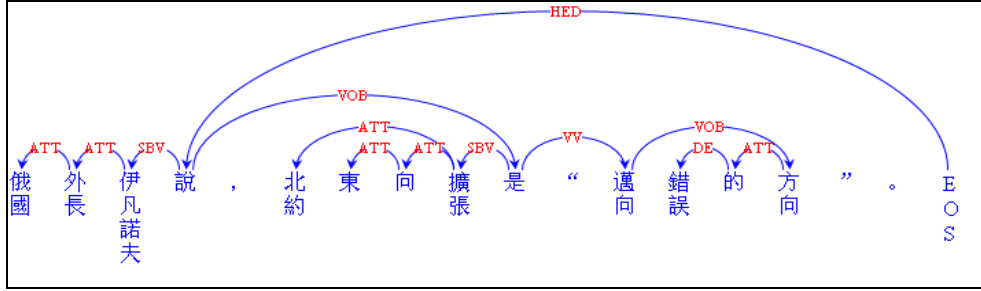


Figure 1. Dependency Tree for Sentence a)

## 4.2 Chinese Sentence Preprocessing (SP)

To enhance the robustness of the dependency parser, named entities are first recognized with a traditional Chinese word segmentation tool with access to the very large LIVAC dictionary (<http://www.livac.org>) collected from Chinese news published in Hong Kong and Taiwan. The identified named entities, as well as the collected reporting verbs and opinion-bearing words are added to the user dictionary of the HIT LTP package to help parsing.

Before parsing, the parentheses enclosing only English words or numbers are removed in sentences, because the parser cannot properly process the parentheses which may greatly influence the parsing result.

## 4.3 Identifying Opinion Holders with Reporting Verbs

### 4.3.1 Holder Candidate Generation

Two hypotheses are used to identify opinion holders in opinionated sentences: 1) the subject of reporting verbs will be the opinion holders; 2) if no reporting verb is found, the author could be the opinion holder. In addition to the two hypotheses above, the following heuristic rules (HR) are used:

1) Other words having relations with reporting verbs

If the subject of reporting verbs is not found in the sentence, we will find the word having relationship of *ATT*, *VOB* or *IS* with the reporting verbs, because sometimes the parser may wrongly marked the subject as other relations.

2) Colon processing in Headlines

If no reporting verbs are found in news headlines, we just pick up the noun before the colon as the target candidate in the headlines because the author usually replaces the reporting verb with a colon due to length limitation. E.g. in the headline 摩根：經濟成長熄火 (*Morgan:*

*Economic growth has been shut down*), the noun 摩根 (*Morgan*) before colon is chosen as the opinion holder.

3) Holder in the previous sentence

If no opinion holder is found in the current clause and one holder candidate is found in the previous clause, we just choose the opinion holder of the previous clause as the holder candidate, because an opinion holder may express several ideas through consecutive sentences or clauses.

### 4.3.2 Holder Candidate Expansion (EP)

Through the procedure of candidate generation, we may find a holder candidate containing only one single word. But the holder may be a word sequence instead of a single word. Thus we further expand the holder candidates from the core head word by the following rules:

1) Attributive modifier (*ATT*)

E.g. in sentence a) mentioned in Sec. 2.2, the subject of the reporting verb 說 (*said*) is 伊凡諾夫 (*Ivanov*), which has the attributive noun 外長 (*Foreign Minister*) modified further by an attributive noun 俄國 (*Russia*). Therefore, the final extended opinion holder would be 外長伊凡諾夫 (*Russian Foreign Minister Ivanov*).

2) Quantifier modifier and 和/及 (*and/or*)

E.g. the quantifier modifier 部分 (*some*) in the noun phrase 部分亞洲國家 (*some Asian countries*) should be part of the opinion holder. Sometime, we need to extend the holder across 和/及 (*and/or*), e.g. 蘇哈托和另外兩名軍方將領 (*Suharto and two other army generals*).

Furthermore, time nouns, numbers and words only containing one Chinese character (except for pronouns) are removed from the candidates, as they are unlikely to be opinion holders.

## 4.4 Identifying Opinion Targets with Opinion-bearing Words

Here we propose to use automatically identified reporting verbs and opinion holders to help opinion target identification. The heuristic rules (**HR**) are as follows.

1) If a candidate of opinion holder is automatically identified with a reporting verb in an opinionated sentence, we will try to find the subject in the embedded clause as the target candidate by the following two steps: a) Find the subject of the object verb of the reporting verb. E.g. in sentence a) in Sec. 2.2, the opinion target *北約東向擴張* (*NATO's eastward expansion*) is the subject of the verb *是* (*was*) in the embedded clause which is in turn the object of the reporting verb *說* (*said*); b) If no target candidate is found in step a, we try to find after the reporting verb the subject whose parent is an opinion-bearing word as the target candidate.

2) If no target candidate is found in step 1, and no opinion holder is found in the sentence, we find the subject of the sentence as the target candidate, because the author may be the opinion holder and the target could be the subject of the sentence.

3) If still no target candidate is found in step 2, we find the object in the sentence as the target because the object could be the opinion target in case there is no subject and no opinion holder.

Target candidate expansion (**EP**) is similar to holder candidate expansion described in Sec. 4.3.2. If an opinion target is in the opinion holder candidates (we call it *holder conflict*, **HC**), we remove it from the target candidates, and then try to find another using the above procedure.

## 5 Experiments

We use the traditional Chinese test data in NTCIR-7 MOAT (Seki et al., 2008) for our experiments. Out of 4465 sentences, 2174 are annotated as opinionated by the lenient standard, and the opinion holders of some opinionated sentences are marked as `POST_AUTHOR` denoting the author of the news article. We use the final list given by the organizers as the gold standard.

### Baselines for opinion holder identification:

Baseline 1: We just use the subject of reporting verbs as the opinion holder, without sentence preprocessing described in Sec. 4.2 and any heuristic rules introduced in Sec. 4.3.1.

Baseline 2: We also implement the CRF model for detecting opinion holders (Choi et al., 2006) by

using CRF++. The training data is the NTCIR-6 Chinese test data. The labels used by CRF comprise Holder, Parent of Holder, None (not holder or parent) and the features for each word in our implementation include: basic features (i.e. word, POS-tag, whether the word itself is a reporting verb or not), dependency features (i.e. parent word, POS-tag of its parent, dependency relation with its parent, whether its parent is a reporting verb) and semantic features (i.e. WSD entry in Tongyici Cilin, WSD entry of its parent).

### Baseline for opinion target identification:

Baseline 1: we try to find the subject or object of opinion-bearing words as the targets. If both a subject and an object are found, we just simply choose the subject as the target.

We evaluate performance using 3 measures: exact match (EM), head match (HM), and partial match (PM), similar to Choi et al. (2006). We use three evaluation metrics: recall (Rec), precision (Pre), and F1. For opinion holder identification, we consider two cases: 1) all opinionated sentences; 2) only the opinionated sentences whose opinion holders do not contain `POST_AUTHOR`. The metric *ALL\_Pre* reported below is the precision in case 1 which is the same with recall and F1.

### 5.1 Results for Opinion Holder Identification

The results for holder identification are shown in Table 1, from which we can observe that our proposed approach significantly outperforms the two baseline methods, including the unsupervised baseline 1 and the supervised baseline 2.

		ALL Pre	Pre	Rec	F1
Baseline1	EM	52.4	46.8	31.6	37.8
	HM	67.1	80.2	54.2	64.7
	PM	72.1	<b>89.3</b>	60.4	72.0
Baseline2 (CRF)	EM	45.5	34.7	18.1	23.8
	HM	55.2	63.6	33.1	43.6
	PM	55.6	64.9	33.8	44.4
Our Approach	EM	<b>69.8</b>	<b>74.4</b>	<b>63.6</b>	<b>68.5</b>
	HM	<b>72.5</b>	<b>79.2</b>	<b>67.7</b>	<b>73.0</b>
	PM	<b>75.7</b>	85.1	<b>72.7</b>	<b>78.4</b>

Table 1. Results for Opinion Holders

Unexpectedly, even the unsupervised baseline 1 achieves better performance than baseline 2 (the CRF-based method). The possible reasons are: 1) the training data is not large enough to cover the cases in the test data, resulting in low recall of the CRF model; 2) the features used by the CRF model could be refined to improve the performance.

Here we also evaluate the influences of the following three factors on the performance: sentences preprocessing (SP) in Sec. 4.2, holder expansion (EP) in Sec. 4.3.2 and the heuristic rules (HR) in Sec. 4.3.1. The results are shown in Figure 2 for different combinations, in which BL refers to baseline 1.

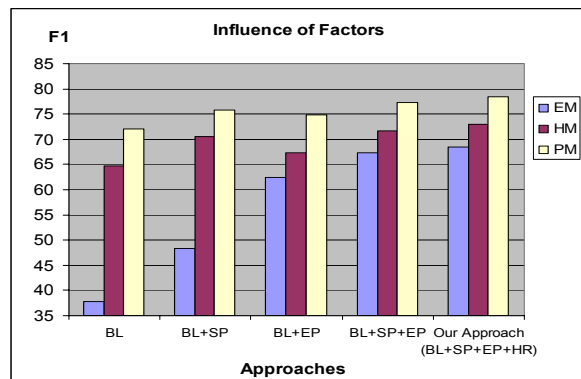


Figure 2. Influences of Factors on Opinion Holders

From Figure 2, we can observe that: 1) All three factors have positive effects on performance compared to baseline 1, and our approach by integrating all factors achieves the best performance; 2) SP improve the performance in terms of all three metrics, showing that SP including named entity recognition and parenthesis removing are useful for holder identification; 3) The major improvement of EP lies in EM, showing that the main contribution of EP is to get the exact opinion holders by expanding the core head noun; 4) SP+EP+HR improves the performance in terms of all three metrics compared with SP+HR, showing the heuristic rules are useful to improve the performance.

## 5.2 Results for Opinion Target Identification

The results for opinion target identification are shown in Table 2, from which we can observe that our proposed approach significantly outperforms the baseline method.

		Pre	Rec	F1
Baseline 1	EM	11.1	9.2	10.1
	HM	24.0	19.9	21.8
	PM	39.4	32.7	35.8
Our Approach	EM	<b>29.3</b>	<b>28.5</b>	<b>28.9</b>
	HM	<b>38.4</b>	<b>38.0</b>	<b>38.2</b>
	PM	<b>59.3</b>	<b>58.7</b>	<b>59.0</b>

Table 2. Results for Opinion Targets

We also investigate the influences of the following four factors on the performance: sentence preprocessing (SP) in Sec. 4.2, target

expansion (EP) in Sec. 4.4, holder conflict (HC), the heuristic rules (HR) proposed in Sec. 4.4. The F1s for EM, HM and PM are shown in Figure 3, in which BL refers to baseline 1.

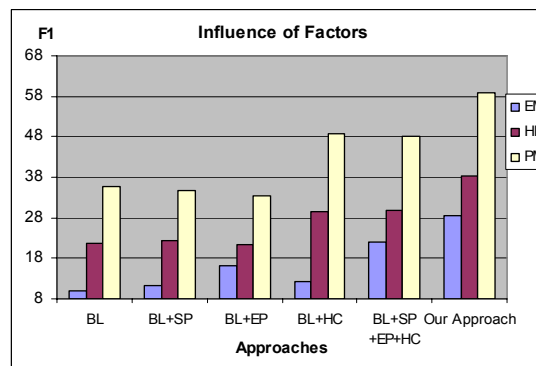


Figure 3. Influences of Factors on Opinion Targets

From Figure 3, we can observe that: 1) All four factors have positive effects on performance compared to the baseline, and our approach integrating all the factors achieves the best performance; 2) EP significantly improves F1 of EM without much improvement on F1 of HM or PM, showing that EP’s major contribution lies in exact match; 3) The major contribution of HC is the improvement of F1s of HM and PM, showing the automatically identified opinion holders are quite helpful for finding opinion targets; 4) SP+EP+HC improves the performance in terms of all three metrics; and our approach further improves the performance by adding HR.

## 5.3 Discussion

Here we compare our results with those reported at NTCIR-7 MOAT traditional Chinese test (Seki et al., 2008). Without considering the errors in the previous step, the highest F1s for opinion holder analysis reported by the four participants were respectively 82.5%, 59.9%, 50.3% and 59.5%, and the highest F1s for target reported by the three participants were respectively 60.6%, 2.1% and 3.6%. Compared to the results at NTCIR-7, our performances on both opinion holder identification in Table 1 and that on target identification in Table 2 seem quite encouraging even by the EM metrics.

Consider the evaluation for opinion holders/targets was semi-automatic at NTCIR-7. We should note that although the generated standard had been supplemented by the participants’ submissions, some correct answers may still be missing, especially for targets since only three teams participated in the target

identification task and the recalls were not high. Thus the performance reported in Table 1 and 2 may be underestimated.

Here we also give an estimate on the percentages of opinionated sentences containing both opinion holders and at least one reporting verb in NTCIR-6 and NTCIR-7's traditional Chinese test data, which are respectively 94.5% and 83.9%. The high percentages show that reporting verbs are very common in news report.

## 6 Conclusion and Future Work

In this paper, we investigate the problem of identifying opinion holders/targets in opinionated sentences of Chinese news texts based on Chinese dependency parser, reporting verbs and opinion-bearing words. Our proposed approach shows encouraging performance on opinion holder/target identification with the NTCIR-7's traditional Chinese test data, and outperforms most systems reported at NTCIR-7 and the baseline methods including the CRF-based model.

The proposed approach is highly dependent on dependency parser, and we would like to further investigate machine learning approaches (including the CRF model) by treating dependency structures as one of the linguistic features, which could be more robust to parsing errors. Opinion targets are more difficult to be identified than opinion holders, and deserve more attention in the NLP field, and we also would extend the targets to verb phrases and embedded clauses in addition to noun phrases. To explore the effectiveness of our approach with English data such as MPQA is another direction.

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