

F-Structure Transfer-Based Statistical Machine Translation

Yvette Graham

Anton Bryl

Josef van Genabith

National Centre for Language Technology

School of Computing

Dublin City University

Dublin 9, Ireland

ygraham, abryl, josef@computing.dcu.ie

1 Abstract

Statistical Machine Translation (SMT) using deep linguistic representations for transfer is a relatively new and growing research area (Bojar and Hajič, 2008; Graham and van Genabith, 2008; Ding and Palmer, 2006; Riezler and Maxwell, 2006; Cmejrek et al., 2003; Eisner, 2003; Hajič et al., 2002; Alshawi et al., 2000). In Transfer-Based SMT, among the different types of intermediate structures used for transfer are dependency structures. Bojar and Hajic (2008) use the Functional Generative Description (FGD) (Sgall et al., 1986) Tectogrammatical Layer (T-layer), labelled ordered dependency trees, while Riezler and Maxwell (2006) use the Lexical Functional Grammar (LFG) (Kaplan and Bresnan, 1982; Bresnan, 2001; Dalrymple, 2001) Functional Structure (F-structure), an attribute-value structure encoding of bilexical labelled dependencies and atomic valued features.

1.1 Transfer-Based SMT

Transfer-Based SMT is composed of three parts, i) parsing to linguistic structure, ii) transfer from SL linguistic structure to TL linguistic structure and iii) generation of TL sentence. Each of the three steps uses a statistical model to select the best or n-best output. For parsing, a disambiguation model is used to rank the parses and select the n-best output parses. Decoding (transfer) is then done on a parse structure (or n-best list of parse structures) via beam-search producing an n-best list of TL structures. For generation, the input is an n-best list of TL structures and all possible TL sentences are produced. The best TL sentence is then selected using an n-gram language model.

1.2 Fstructure-Based Transfer Rule Acquisition

In this paper, we describe a Transfer-Based SMT system that, like Riezler and Maxwell (2006), uses the LFG F-structure as the intermediate representation for transfer and is trained fully automatically on LFG-parsed bilingual corpora. Riezler and Maxwell (2006) used SMT phrases to hypothesize candidate transfer rules. We take a different approach to rule induction and hypothesize rules only using information from the f-structures, as opposed to using SMT phrases based on the surface form strings. We do this by firstly establishing a set of one-to-one correspondences between local f-structures,¹ before inducing all rules consistent with these alignments.

1.3 Experimental Evaluation

The transfer rule acquisition component uses context variables (Maxwell and Kaplan, 1991) to encode large numbers of rules in a compact representation and has been fully implemented and tested on Europarl (Koehn et al., 2005) and Newswire corpora. We plan to include an experimental evaluation of the complete machine translation system in which we investigate the effects of using two different disambiguation models for parsing the data used by the SMT system. Riezler and Maxwell (2006) tested their machine translation system using an English disambiguation model for both sides of the training corpus. If a single disambiguation model is used, the f-structures of a given pair of training sentences are likely to be quite similar, and this may help the rule induction process. However, another approach is to use language-specific disambiguation models for parsing. In this case, it is more likely that the *actual* best f-structure for each sentence of the training data is selected. The rule induction algorithm must then induce rules from the output structures regardless of how dissimilar they are. We conduct an empirical investigation into which

¹We currently carry out node alignment as follows: Giza++ (Och et al., 1999) is run in both language directions on a lemmatized version of the bitext training corpus and the intersection of the two sets of alignments is gotten using Moses (Koehn et al., 2007).

approach achieves better machine translation output by training and testing the machine translation system using i) an English disambiguation model (Kaplan et al., 2004; Riezler et al., 2002) to select the best parse for both German and English sentences, and compare with results when ii) a German disambiguation model (Forst, 2007) is used for selecting the best German parse and an English disambiguation model (Kaplan et al., 2004; Riezler et al., 2002) is used to select the best parse for the English sentences. For the evaluation the system is trained on the Europarl (Koehn et al., 2005) and Newswire parallel corpora and tested on held-out data.

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