

Japanese Speech Understanding Using Grammar Specialization Demo Script

Demonstrator: “We will demonstrate the effects of grammar specialization in terms of recognition accuracy and processing speed in the context of MedSLT, a speech-to-speech translator for medical domains. Do you know any Japanese? If not, we will briefly introduce you to the Japanese MedSLT grammar. Let us analyze the Japanese example sentence “netsu wa ari masu ka”.

One of the characteristics of Japanese is that a particle determines the grammatical function of a word. In our example, the particle “wa” attaches to the noun “netsu” marking its role as a subject. “Netsu” means “fever”.

In MedSLT we distinguish two verb forms for Japanese: plain (常体) and polite (敬体).

The polite form is used at main clauses, while the plain form is used at subordinate clauses.

“Ari masu” is the polite form of the verb “aru”, which means, “be” or “exist”.

“Ka” is put at the end of the sentence to form a question.

Thus “netsu wa ari masu ka” is analyzed as follows “fever-TOPIC is-POLITE-Q”, which translates to English as “do you suffer from fever”. In the English translation, the subject is “you” and “fever” is the object. This is a typical difference between Japanese and English, since Japanese is a pro-drop language, while English generally requires overt subject pronouns.

Now let’s get acquainted with the MedSLT application window. The left side of the application window is an image map, which allows us to select sub-domains, such as headaches, chest pain, abdominal pain, etc. We currently have selected the headache domain. MedSLT supports several source and target languages through an interlingua-based translation engine.

Our source language is Japanese and the target language is French. The “S” in the flag of the source language indicates that the source language uses a recognition package that is derived from the specialized part of the grammar. Before we start using the system we will address the issue of grammar specialization.”

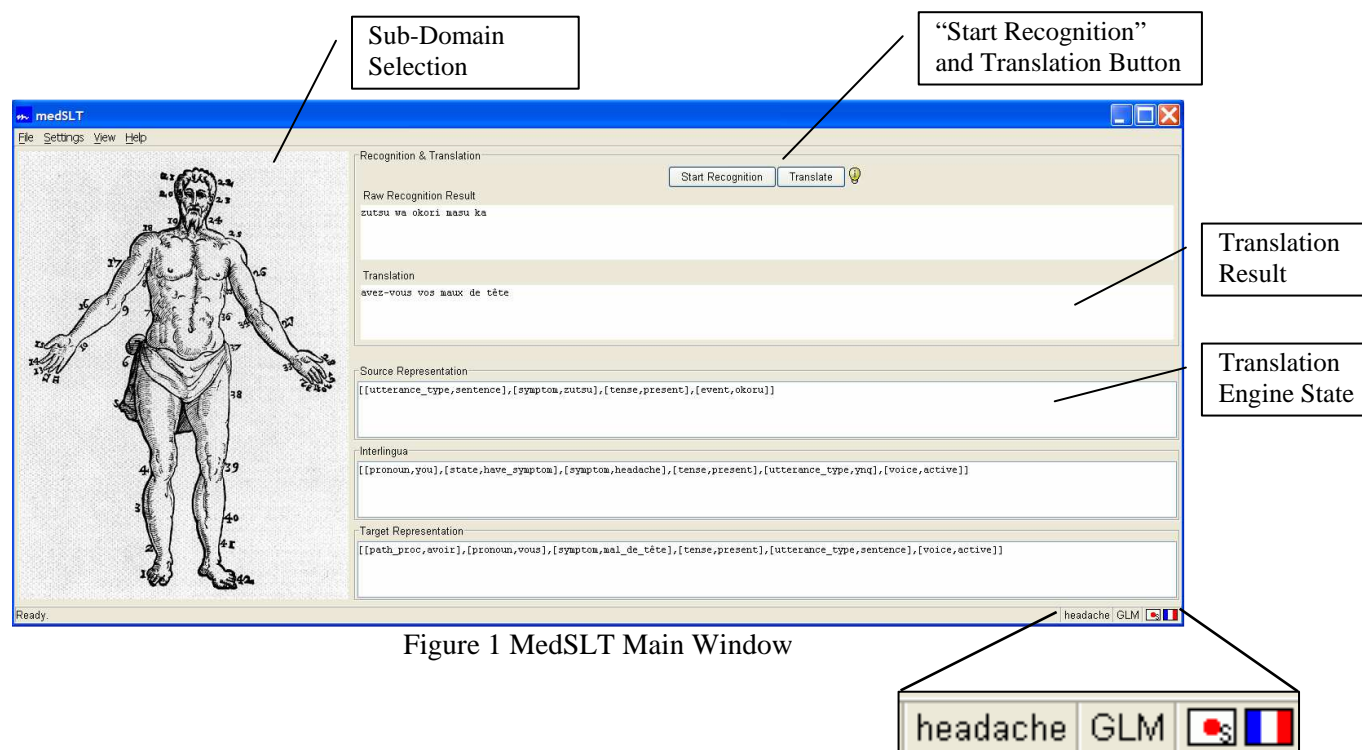


Figure 1 MedSLT Main Window

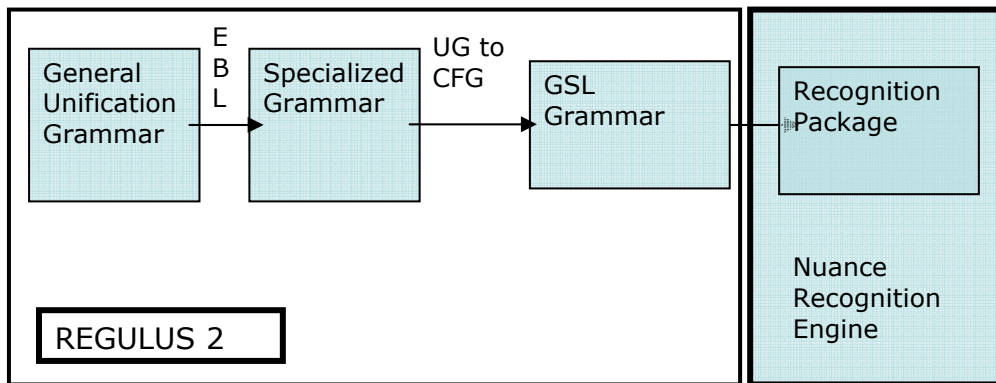


Figure 2 Compilation of the Specialized Grammar

“Figure 2 shows how the specialized grammar is compiled. We start with a general, domain-independent typed unification grammar. We then restrict the coverage of this general grammar by applying Explanation Based Learning using a small training corpus, with a few hundreds of domain specific sentences. The process constructs a new grammar that has simpler, flatter structure and only produces constructions licensed by the training corpus. The final step is to convert the resulting grammar into a probabilistic context free GSL grammar, which we finally compile into a Nuance recognition package.”

Demonstrator selects the MedSLT window, presses the recognition button and utters the first question in Japanese. A sample sentence is shown in the table below. The source language part contains Japanese, Romanized Japanese, and a literal translation annotated with grammatical features. For French the resulting translation along with a word-by-word translation to English are shown.

Japanese	痛みは激しいですか
	itami wa hageshii desu ka
	<i>pain-TOPIC intense is-POLITE-Q</i>
French	la douleur est-elle intense?
	<i>the pain is-it intense</i>

System recognizes the sentence, and at the status bar a timing indicator appears indicating CPU time required to process the spoken utterance. The demonstrator then presses the translate button, and the French sentence gets synthesized.

Demonstrator:“This question is about the degree of the headache. “Itami” means “pain” (douleur), “hageshii” is the adjective and the meaning is “intense” (intense). “Desu”, which basically is an auxiliary verb, is here attached to the adjective “hageshii” and it functions like the verb “be” (être). “Ka” is the question particle. The English translation to this is “is the pain intense”. Let’s try some other sentences.”

Japanese	痛みは頭の前の方ですか
	itami wa atama no mae no hou desu ka
	<i>pain-TOPIC head-GEN front-GEN-direction is-POLITE-Q</i>
French	avez-vous mal sur le devant de la tête ?
	<i>have-you pain on the front of the head</i>

Japanese	痛みは顔まで広がりますか
	itami wa kao made hirogari masu ka
	<i>pain-TOPIC face-DESTINATION radiates-POLITE-Q</i>
French	la douleur irradie-t-elle le visage ?
	<i>the pain radiates-it the face</i>

CPU time consumed, using the specialized grammar, averages to 0.076xRT on a sample set of 300 sentences on measured on a 3.2GHz mobile Pentium 4 processor. This means that the recognition result appears almost instantly after the user has finished uttering the sentence.

Demonstrator: “We notice that there is a consistent pattern in how long it takes to recognize an utterance. Wall clock times are in the range of 2.5 and 4 seconds, depending how long the sentence is, while CPU time is in the order of 0.07. Recognition also worked remarkably well for all sentences. Let’s try to switch to the non-specialized version of the grammar.”

Demonstrator brings up the language selection dialogue. The non-specialized Japanese system is selected.

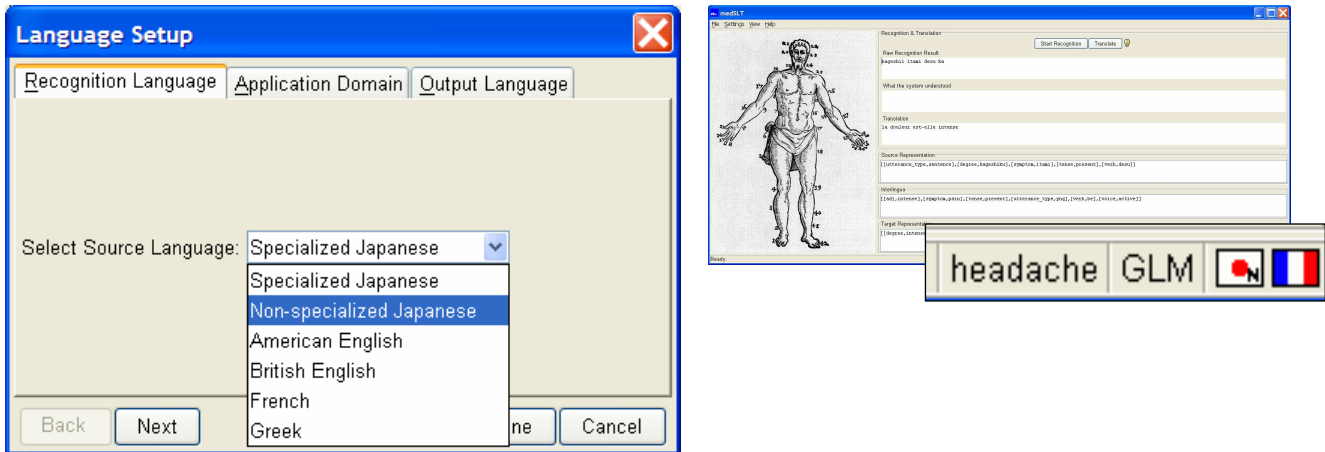


Figure 3 Changing source-language recognition package to the non-specialized version

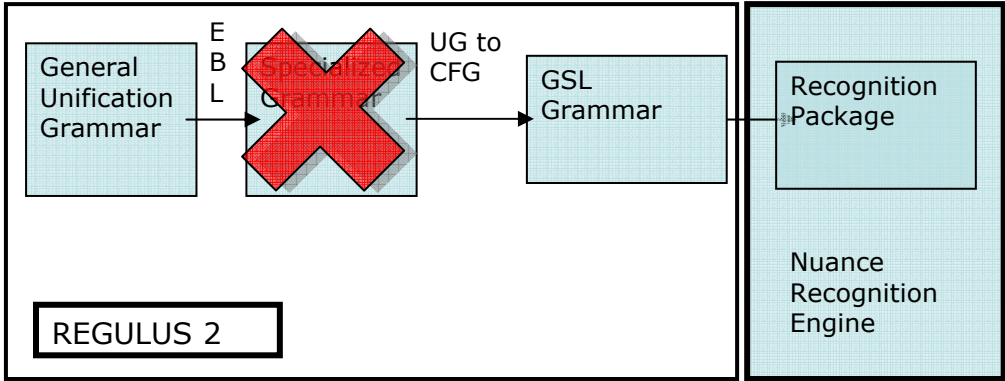


Figure 4 Compilation of Non-Specialized Grammar

Demonstrator: “The non-specialized version of the grammar is directly compiled into a context free GSL grammar, by skipping the EBL training step, as shown in Figure 4. Let’s try to use this recognition package for our application.”

During demonstration of following sentences, it will be clear that recognition times are considerable higher. While CPU time of the specialized version averages to 0.076xRT, the non-specialized version requires an average of 1.458xRT. This means that the recognition result will be available long after the user finished talking.

Additionally WER for the non-specialized system is approximately twice as high compared to the specialized system. During the course of the demonstration, we will need to utter a particular sentence more than once to eliminate misrecognitions. Differences in both versions of the system are striking, and are evident even to the first time user.

Japanese	いつ頭痛は起こりますか
	itsu zutsu wa okori masu ka
	<i>when headache-TOPIC happens-POLITE-Q</i>
French	quand avez-vous vos maux de tête ?
	<i>when you-have your pains of head</i>
Japanese	朝頭痛は起こりますか
	asa zutsu wa okori masu ka
	<i>morning headache-TOPIC happens-POLITE-Q</i>
French	avez-vous vos maux de tête le matin ?
	<i>have-you your pains of head the morning</i>
Japanese	毎日頭痛は起こりますか
	mainichi zutsu wa okori masu ka
	<i>everyday headache-TOPIC happens-POLITE-Q</i>
French	avez-vous vos maux de tête chaque jour ?
	<i>have-you your pains of head every day</i>
Japanese	十分以上頭痛が続きますか
	juppun ijou zutsu ga tsuzuki masu ka
	<i>ten-minutes more-than headache-SUBJECT lasts-POLITE-Q</i>
French	vos maux de tête durent-ils plus de dix minutes ?
	<i>your pains of head last-they more than ten minutes</i>

Demonstrator: “Now, let’s change target language to English.”

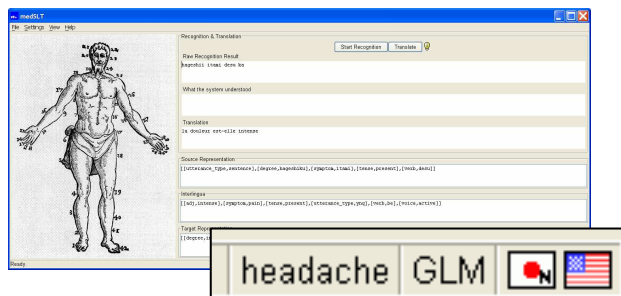
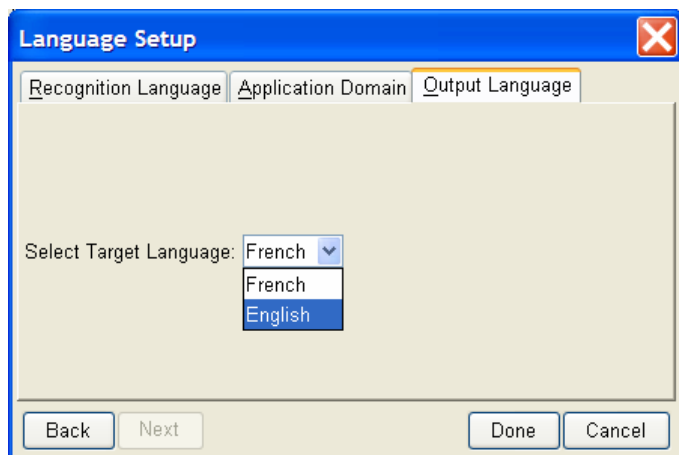


Figure 5 Changing target language to English

Japanese	急な温度の変化があると頭痛はひどくなりますか kyuuna ondo no henka ga aru to zutsu wa hidoku nari masu ka <i>sudden-TOPIC temperature-GEN change-SUBJECT is-PLAIN-COND headache-TOPIC severe becomes-POLITE-Q</i>
English	are the headaches worse when you experience sudden temperature changes?

Demonstrator: “We tried a sentence with a subordinate clause. In Japanese, the subordinate clause “kyuuna ondo no henka ga aru to” is placed before the main clause “zutsu wa hidoku nari masu ka”. Now let’s try some sentences about causes of headaches.”

Japanese	何をするとう頭痛は起こりますか nani wo suru to zutsu wa okori masu ka <i>what-OBJ do-PLAIN-COND headache-TOPIC occurs-POLITE-Q</i>
English	what causes the headaches?

Japanese	テレビを見ると頭痛は起こりますか terebi wo miru to zutsu wa okori masu ka <i>TV-OBJ watch-PLAIN-COND headache-TOPIC occurs-POLITE-Q</i>
English	do you have the headaches when you watch TV?

Japanese	本を読むと頭痛はひどくなりますか hon wo yomu to zutsu wa hidoku nari masu ka <i>book-OBJ read-PLAIN-COND headache-TOPIC severe becomes-POLITE-Q</i>
English	are the headaches worse when you read?

Japanese	背骨を動かすと頭痛はひどくなりますか sebone wo ugokasu to zutsu wa hidoku nari masu ka <i>spine-OBJ move-PLAIN-COND headache-TOPIC severe becomes-POLITE-Q</i>
English	are the headaches worse when you move the spine?

Japanese	咳をすると頭痛が起こりますか
	seki wo suru to zutsu ga okori masu ka
	<i>cough-<u>OBJ do-PLAIN-COND headache-SUBJECT occurs-POLITE-Q</u></i>
English	do you have the headaches when you cough?

Japanese	赤ワインを飲むと頭痛が起こることがありますか
	aka wain wo nomu to zutsu ga okoru koto wa ari masu ka
	<i>red-wine-<u>OBJ drink-PLAIN-COND headache-SUBJECT occur-fact-SUBJECT exist-POLITE-Q</u></i>
English	do you have the headaches when you drink red wine?

Japanese	騒音で頭痛がひどくなりますか
	souon de zutsu wa hidoku nari masu ka
	<i>noise-<u>CAUSE headache-SUBJECT severe becomes-POLITE-Q</u></i>
English	are the headaches worse when you experience noise?

Demonstrator: “Let’s assume that the doctor wants to ask some more causal questions.”

Japanese	どうすれば頭痛が治まりますか
	dousureba zutsu wa osamari masu ka
	<i>how-do-<u>PLAIN-COND headache-SUBJECT settles-POLITE-Q</u></i>
English	what makes the headaches better?

Japanese	睡眠をとると頭痛は治まりますか
	suimin wo toru to zutsu wa osamari masu ka
	<i>sleep-<u>OBJ take-PLAIN-COND headache-TOPIC settles-POLITE-Q</u></i>
English	are the headaches better when you sleep?

Japanese	暗い部屋にいると頭痛が治りますか
	kurai heya ni iru to zutsu ga naori masu ka
	<i>dark room <u>LOC stay-PLAIN-COND headache-SUBJECT settles-POLITE-Q</u></i>
English	are the headaches better when you experience dark room?

Japanese	心電図を受けたことがありますか
	shindenzu wo uketa koto ga ari masu ka
	<i>ECG-<u>OBJ had-PLAIN-fact-SUBJECT exist-POLITE-Q</u></i>
English	did you have an ECG?

Japanese	C T スキャンを受けたことがありますか
	c t sukyan wo uketa koto ga ari masu ka
	<i>CAT-scan-<u>OBJ had-PLAIN-fact-SUBJECT exist-POLITE-Q</u></i>
English	did you have a CAT scan?

Demo Requirements

We will bring the demo installed on our own laptop. The system is speech in/speech out and the screen will be used for demonstration purposes. If a board is available, we will bring a poster showing the system architecture.