Greek Speech Processing in Robotics

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The research field of robotics has been making progress the last years, including combining navigation with natural language interaction. We provide the current state-of-the-art of speech processing in robotics, its challenges, and our contribution.

Haage et al. (2002) developed a speech system to design robot trajectories that would fit with computer-aided design paradigms. Motallebipour & Bering (2003) developed a speech dialogue system for solving relocation tasks using an industrial robot arm; they used context free grammar (CFG) to control the robot arm. More recently, Mubin et al. (2010) developed an artificial language called ROILA to make it easy for humans to learn, and for the robots to understand. The grammar used has four parts-of-speech: nouns, verbs, adverbs, and adjectives and four pronouns (I, you, he, she). The dialogue component implemented in Godot (Theobalt et al. 2002), a mobile robot platform, used Discourse Representation Structures (DRS).

At the German Research Center for Artificial Intelligence (DFKI) there is a Bremen Ambient Assisted Living Lab (BAALL[1]), an apartment suitable for the elderly and people with physical or cognitive impairments. In BAALL there is an autonomous wheelchair called "Rolland" which is equipped with sensors and a PC, and serves mobility assistance. It has a speech input control interface and by means of a grammar, it can navigate according to spoken commands of the user. Currently, commands can be provided in German and English.

The current challenges of speech support in robotic devices are i) monolinguality, ii) limited vocabulary – often not natural language, iii) simple syntactic structures. Our contribution is to expand by means of morphosyntactic rules and ontology-based activites the grammar of "Rolland". Our experiments with Greek have the following workflow:

i. Rolland's German grammar is machine-translated into Greek;
ii. User speaks in Greek through an Automatic Speech Recognition (ASR) tool;
iii. Rolland reacts according to the user's command(s);
iv. Rolland speaks back in Greek (if needed or wanted).

Although Greek is a morphologically rich language and thus more difficult to be machine-translated, the controlled language lowers the word error rate. We expand the grammar lexically, morphologically, and syntactically in order to achieve a more natural, intuitive, and efficient spoken dialogue interaction.

In a nutshell, our contribution is a language-independent speech to speech translation system (with the distinction from traditional systems that the output is in the source language – users' mother tongue) for a more natural and efficient human-robot interaction in a domestic environment for the elderly and people with impairments.

References

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[1] http://www.dfki.de/web/living-labs-en/baall-2013-bremen-ambient-assisted-living-lab-1?set_language=en&cl=en, 28/01/11.