



Natural Human-Robot
Cooperation in Dynamic
Environments

Natural cooperation:

How could humans and robots work together like team members? NIFTi focuses on building cognitive robots that support humans in exploring dynamic real-life environments. Key to the NIFTi approach is that the robot **bears the human in mind**. NIFTi integrates human factor models throughout the cognitive system, so the robot can understand how a human team-member can be "best" supported in a given situation, while performing under stress.

Human-robot
teams working
together to assess
real-life urban
disaster sites



To effectively act as a team-member, a robot needs to do more than just perform its own tasks well. It needs to understand how its own behavior, and the dynamics of exploring an environment together with a human, can affect the human's abilities to act and understand. Only then can the robot react to or even anticipate such contexts, and really support a human as team-member.

Much research has gone into how robots can function autonomously, as members of a team. They work on their own, moving around, executing their assignments. NIFTi adds a perspective on collaborative teamwork to this task-oriented autonomy in operation. NIFTi investigates how a cognitive robot can complement models of its own capabilities and situation awareness, with cognitive user models of task load and workflow.

NIFTi works off the hypothesis that a combination of these models can achieve natural human-robot cooperation. The idea is to continuously balance how to operate autonomously, with how to collaborate so as to minimize task load for the human, and optimize workflow. NIFTi calls this the naturalness loop. To bring this about, NIFTi does not see user models as just another box in an architecture. On the contrary. The human factor pervades most of the robot's models and decision procedures. How it understands the environment. How it combines its situation awareness with user models to estimate what a human might pay attention to. How a

situation may affect a human's task load. To estimate, basically, how a human may act or react in a dynamic environment. So that the robot can accordingly try to adapt what it does, decides to do or say next, when, how.

NIFTi aims at an integrated account of how natural human-robot collaboration can come about. The account will be instantiated in several generations of integrated systems. Each year, systems will be evaluated with several USAR end user organizations. Rescue personnel will team up with NIFTi robots (UGV and UAV) to carry out realistic missions, in real-life training areas. These missions include tunnel accidents, warehouse fires, collapsed buildings, and railway yard chemical spills. Initially, the human collaborates with the robot from a remote site, out of the hot zone. Later on in the project, the team will also include in-field rescue personnel. NIFTi develops a novel rover platform to support real-life missions.

The end users are closely involved in the entire S&T cycle, from formulating use cases and functionality requirements, to field trials and evaluations at component & system-level.



Coordinator:

G.J.M. Kruijff (gj@dfki.de)
DFKI GmbH, Saarbrücken Germany

Consortium:

DFKI GmbH, TNO Human Factors, Fraunhofer IAIS, Bluebotics, ETH Zürich, Czech Technical University, "La Sapienza" University, Fire Department of Dortmund, Corpo Nazionale dei Vigili del Fuoco.

Internet: <http://www.nifti.eu>