In order for humans and machines to communicate, brain waves of the pilots are measured using electroencephalography (EEG) electrodes connected to a cap.

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Using Thoughts **to Control Airplanes**

Pilots of the future could be able to control their aircraft by merely thinking commands. Scientists at TUM and TU Berlin have demonstrated the feasibility of flying via brain control – with astonishing accuracy.

The pilot is wearing a white cap with myriad attached cables. His gaze is concentrated on the runway ahead of him. All of a sudden, the control stick starts to move, as if by magic. The airplane banks and then approaches straight on toward the runway. The position of the plane is corrected time and again until the landing gear gently touches down. During the entire maneuver the pilot touches neither pedals nor controls.

This is not a scene from a science-fiction movie, but rather the rendition of a test at the TUM Institute for Flight System Dynamics. Scientists working for Prof. Florian Holzapfel are researching ways in which brain controlled flight might work in the EU-funded project "Brainflight."

"A long-term vision of the project is to make flying accessible to more people," explains aerospace engineer Tim Fricke, who heads the project at TUM. "With brain control, flying, in itself, could become easier. This would reduce the work load of pilots and thus increase safety. In addition, pilots would have more freedom of movement to manage other manual tasks in the cockpit."

Surprising accuracy

The scientists have logged their first breakthrough: They succeeded in demonstrating that brain-controlled flight is indeed possible – with amazing precision. Seven subjects took part in the flight simulator tests. They had varying levels of flight experience, including one person without any practical cockpit experience whatsoever. The accuracy with which the test subjects stayed on course by merely thinking commands would have sufficed, in part, to fulfill the requirements of a flying license test. "One of the subjects was able to follow eight out of ten target headings with a deviation of only 10 degrees," reports Fricke. Several of the subjects also managed the landing approach under poor visibility. One test pilot even landed within only a few meters of the centerline.

The TUM scientists are now focusing in particular on the question of how the requirements for the control system and flight dynamics need to be altered to accommodate the new control method. Normally, pilots feel resistance in steering and must exert significant force when the loads induced on the aircraft become too large. This feedback is missing when using brain control. The researchers are thus looking for alternative methods of feedback to signal when the plane's capabilities are pushed too hard, for example.

Electrical potentials are converted into control commands. In order for humans and machines to communicate, brain waves of the pilots are measured using electroencephalography (EEG) electrodes connected to a cap. An algorithm developed by scientists from Team PhyPA (Physiological Parameters for Adaptation) at TU Berlin allows the program to decipher electrical potentials and convert them into useful control commands.

Only the very clearly defined electrical brain impulses required for control are recognized by the brain-computer interface. "This is pure signal processing," emphasizes Fricke. Mind reading is not possible. *Stefanie Reiffert (TUM)*