ACTIVE STRETCHER CONTROL DEVICE FOR IMPROVING MOUNTAIN S.A.R. HELICOPTER MISSIONS

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Abstract

The paper briefly describes an active device to control and stabilize the stretcher during the SAR missions with helicopter. After an introduction that explains the typical difficulties happening during SAR operations by means of stretcher recovered into the helicopter cabin using a cable, some details about the proposed control device are reported.

1 Introduction

Mountain rescue missions are often operated with the aim of helicopters. The capability of these machines to perform hovering and close to ground operations is many a time vital for granting the success of extreme and delicate operations. The un-accessibility of many tracks to to any kind of vehicle and in some times also to men, requires well trained helicopter pilots and rescue operators who are many times facing unconventional scenarios with any kind of weather and light. Sometimes, moreover, the rescue mission compels the recovering of severely injured persons who are unable to move due to accidents. Given these premises, the helicopter is turned into a fully equipped flying ambulance, where pilots and rescue operators work in team with medical staff. The injured man thus is recovered by the helicopter and loaded inside the cabin with the help of a powered winch. This part of the rescue mission, in particular, is the most delicate because the patient, who is tightly tied to a special stretcher, is loaded inside the cabin by an operator placed inside helicopter cabin who is operating a powered winch. Such an operation takes some time and during this transient the patient is accompanied by a medic or by a rescue operator who is hanging mid air connected to the same cable which is loading the stretcher. During this operation the stretcher is directly invested by the helicopter rotor downwash and swirl, which generates a rotation attitude of the stretcher itself. This situation often occurs in some particular working conditions, especially when the stretcher is hanging downstream from the helicopter at a quite close distance, ranging between 40 to 10m. After a very short transient the stretcher, which rotates around the sustaining cable, reaches high rotational speed (which when measured showed to be high as 2 rev/s), hence resulting harmful at first to the patient itself, and also dangerous for the medic and or the operator who is following the patient.

Operational manuals and protocols, because of this happening, in fact do prescribe to adopt two operators during this specific phase: at first a medic, who is following the patient ascent to the helicopter, and a second person, who is staying on the ground, holding a rope connected to the stretcher, preventing the above mentioned rotation attitude. As it can be easily perceived, usage of two persons in stead

of one highly complicates the maneuver and, sometimes, because of the extremely unaccessible ground, also compels a second mission to reload the ground operator.

2 Control Device Description

Starting from an idea proposed by an experienced rescue pilot, Politecnico di Milano, together with the mountain rescue team located in Trento, has developed a special device which, once applied to the stretcher, is capable of stabilizing it, taking advantage of the rotor downwash. This device consists in a very simple actively controlled wing (based on a symmetric airfoil), oriented according to rotor downwash stream.

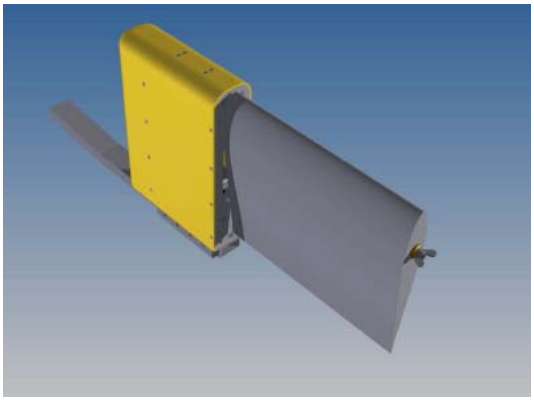

Fig.1: Conceptual design of control device

A simple (and controlled) deflection of this small wing produces a small amount of lift which is used to generate a rotation moment sufficient to stabilize the stretcher during its travel from ground to the cabin.

The device is embedding a very simple control system, based on the concept of velocity feedback, which has been commonly adopted and applied within aeroelasticity and flight mechanics covering a very wide range of different purposes.

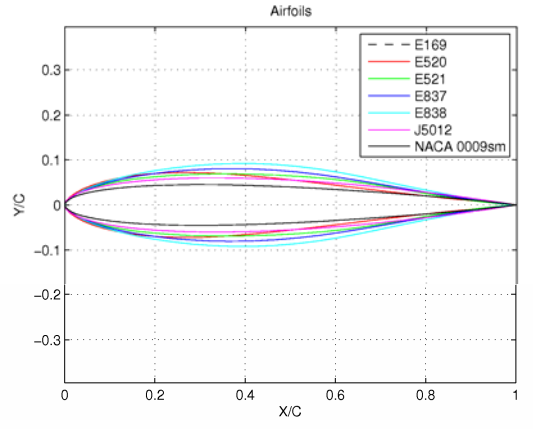

Fig.2: Selection of the airfoil by means of numerical analysis using XFOIL program.

To investigate the feasibility of this concept, very simple numerical models have been developed with the only aim of evaluating the effectiveness of the control logic to be realized.

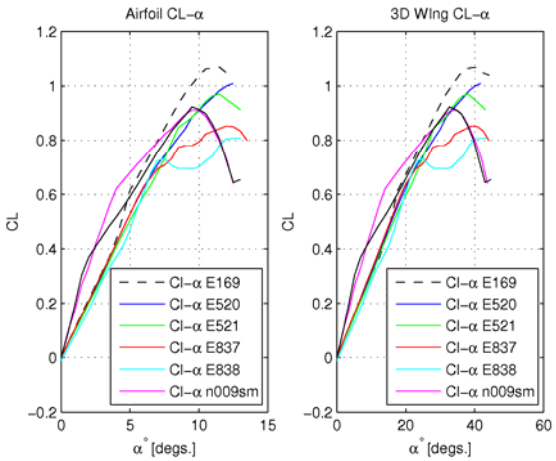

Fig.3: Comparison of different airfoils tacking into account of 3D effects for the control wing.

The prototype of the device has been designed and realized at Politecnico di Milano, with a very short wind tunnel testing campaign that helped in evaluating, at first, the basic aerodynamic behavior of the lifting surface that was there installed and subsequently also the robustness of the control hardware.

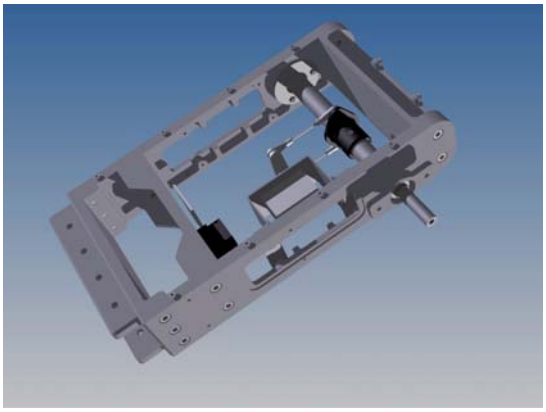

Fig.4: Sketch of the first prototype of control device.

Once preliminary tested, the device, has been finally installed on a dummy stretcher and flight tested at first in a safe open location and later, thanks to the stability achieved by the stretcher by means of the device, also replicating difficult environmental conditions. The device consistently damps stretcher rotational attitude, providing a very safe winch rewind and patient rescue.

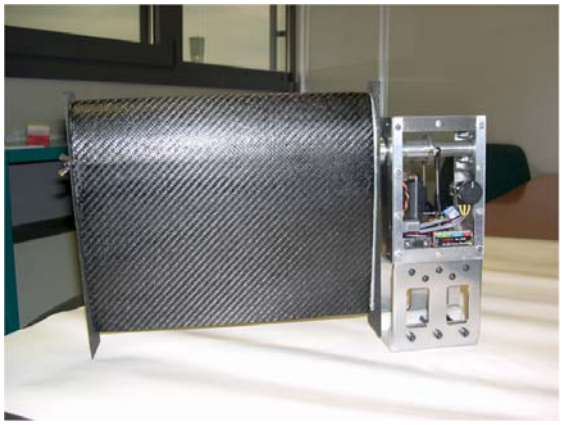

Fig.5: The final version of the control device.

Fig.6: The stretcher with the control device installed on the rear position.

Fig.7: The stretcher fully stabilized during the recovery into the helicopter cabin: image taken during the flight test of the first prototype.

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