Perceptual-motor coupling betwwen Helicopter and ship during ship deck landing maneuvers

Mr THOMAS, Mathieu (DTIS, ONERA), Mr PEREIRA FIGUEIRA, José (Instituo de Pesquisas e Ensaios em Voo, São José dos Campos, Brazil); Mr SERRES, Julien (Aix Marseille Univ, CNRS, ISM, Marseille, France); Mr RAKOTOMAMONJY, Thomas (DTIS, ONERA); Mr RUFFIER, Franck (Aix Marseille Univ, CNRS, ISM, Marseille, France); Mr MORRICE, Antoine (Aix Marseille Univ, CNRS, ISM, Marseille, France)

Content

Helicopter ship landings are challenging operations appealing for further researches and innovations to help pilots safely dealing with a variety of environmental, visual and operational contexts. Indeed, landing on ship not only differs from land-based landings in the extent that the landing area is located on the flight deck, which is most of the time oscillating, but also because the visual environment is often impoverished (e.g., rain, fog, night conditions). In order to improve safety at deck-landing, the French Aerospace Lab (ONERA) and the French Defense Agency (DGA) are interested in understanding pilots' perceptual-motor strategies involved in a such complex task so as to design ecological interfaces assisting pilots' landing maneuvers.

The coupling between the heave movements of the ship's deck and the helicopter altitude was investigated during ship landing maneuvers performed by expert pilots in an immersive simulator (PycsHel fixed-base rotorcraft simulator, ONERA). Heave movements of the ship's deck resulted from the experimental manipulation of the sea state. Pilots were required to fly the full maneuver including approach to the deck, hover alongside, transition flight to hover over landing target and touchdown. Helicopter and ship altitude signals were bined as a function of helicopter-deck distance. Firstly, Spearman's correlation coefficients between the two signals were computed within each bin to investigate the dynamics of the helicopter-deck coupling throughout the full maneuver. Secondly, Spearman's correlation coefficients between the energy at impact and the correlation coefficients previously gained during the final 15 meters of the landing maneuver were computed to determine whether helicopter-deck coupling aimed at minimizing energy at impact.

The helicopter-deck coupling was featured during the full landing maneuver by three phases: after a first uncoupled flight toward the ship (approximately at 450m from ship, i.e. approximately at 50% of the starting distance from ship), pilots secondly synchronized the helicopter's movements with the ship's one, and thirdly phased the helicopter movements with the deck's one during the final part of the maneuver (i.e., hover and touchdown). The helicopter-deck coupling increased with the increase of ship's heave movements resulting from the sea state manipulation. When focusing on the final part of the maneuver, we evidenced that the higher the helicopter-deck coupling was, the lower the energy at impact is. Together, these results suggest that pilots might couple their helicopter's altitude to the ship's heave movements in a functional way, aiming at improving their safety by reducing the energy at impact. This preliminary investigation brought fruitful insights into possible descriptions of ship landing complexity as well as into related interface design.

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