12-2019

Mitigating the Risk of Bird Strikes: The Use of Virtual Reality During Flight Training

Flavio A. C. Mendonca Ph.D.
Embry-Riddle Aeronautical University, coimbraf@erau.edu

Julius Keller Ph.D.
Purdue University, keller64@purdue.edu

Chien-tsung Lu
Purdue University, ctlu@purdue.edu

Chenyu Huang Ph.D.
University of Nebraska Omaha, chenyuhuang@unomaha.edu

Mitigating the Risk of Bird Strikes: The Use of Virtual Reality During Flight Training

Flavio A. C. Mendonca, Ph.D., Julius Keller, Ph.D., Chien-tsung Lu - Purdue University

Chenyu Huang, Ph.D. - University of Nebraska Omaha

Introduction

There were 193,969 wildlife strikes in the US from 1990 through 2017. Wildlife strikes annually cost the US civil aviation industry, on average, $186 million in monetary losses and 111,284 hours of aircraft downtime (Dolbeer & Begier, 2019). According to the Federal Aviation Administration (FAA), Aeronautical Decision-Making (ADM) is a systematic approach that encourages pilots to identify hazards and manage risks (FAA, 2016). Additionally, it helps aviators to make timely and safe decisions. Even though it is practically impossible to eliminate the risk of bird strikes, crewmembers play a vital role in the accident prevention process (Mendonca, Carney, & Fanjoy, 2018), especially outside the airport environment (Dolbeer & Begier, 2019). Crewmembers can mitigate the risk of aircraft accidents due to birds through adequate flight planning and the use of appropriate aircraft operating techniques, among other strategies.

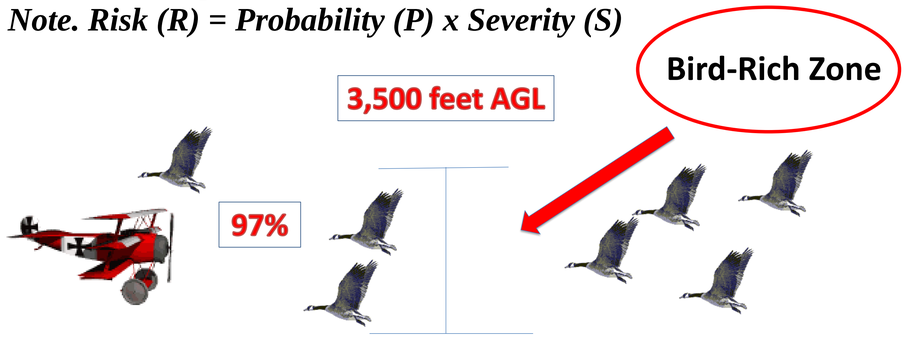
Virtual Reality (VR) technologies that utilize electronic eyewear to immerse an individual in a computer-simulated environment are considered an emerging tool for providing immersive, engaging and autonomous learning environments both for academic and professional purposes. Recent technological advances have increased the resolution and dramatically reduced the cost of deploying VR simulations (Pantelidis, 2009). The purpose of this study is to design and evaluate virtual reality (VR) simulations that could help pilots develop the capacity to identify and mitigate the risk of aircraft accidents due to birds utilizing the ADM tenets.

PURDUE UNIVERSITY | School of Aviation and Transportation Technology, POLYTECHNIC INSTITUTE

Flight Crew Guide to Prevent Bird Strikes Using ADM Concepts

1. Review available information on the risk of bird strikes related to the entire flight (R);
2. Plan the flight to operate above the bird-rich zone as much as possible during the entire flight (P);
3. Use speeds and flaps settings that provide the best angle of climb speed during initial climb-out (P);
4. Reduce flight time in the bird-rich zone (P);
5. Reduce airspeed while in the bird-rich zone (S);
6. Reduce engine power in the bird-rich zone if operationally possible (S);
7. Use the aircraft external lights, especially the landing lights, while flying in the bird-rich zone to enhance the detection of the aircraft by certain bird species (P);
8. Pull up if encountering birds, consistently with adequate flying techniques (P);
9. Listen to air traffic control to obtain up-to-date information on bird hazards (R);
10. Plan descent and approach in order to minimize flight time and airspeed while in the bird-rich zone (R);
11. Descend with minimum power and avoid low-altitude level flight if operationally possible (R); and
12. Consider a go-around if birds are encountered, but only if the go-around can be initiated without striking birds after power is increased (S).

Note. Risk (R) = Probability (P) x Severity (S)



Methodology

The target population will be Part 141 collegiate aviation pilots. Researchers will use a pretest-posttest experimental design utilizing one control group and one experimental group. After the pretest, the treatment group will participate in a learning session utilizing VR scenarios, evaluated in flight simulator scenarios, and then asked to complete the posttest process. The control group will follow the same process except their learning session will be a traditional lecture.

RANDOM ASSIGNMENT	GROUP 1	PRETEST	VR	POSTTEST
	GROUP 2	PRETEST	TRADITIONAL LECTURE	POSTTEST

Conclusion

The conflict between wildlife and aviation is a safety issue and carries with it growing economic losses in the aviation industry. Commercial air traffic in the U.S. is predicted to grow at a rate of about 1.1% per year from 24.5 million movements in 2014 to 30.3 million by 2030 (Dolbeer & Begier, 2019). Additionally, the active commercial aviation fleet is forecast to increase 0.9 percent a year between 2018 and 2036 (FAA, 2019). Therefore, the risk of wildlife strikes is also likely to increase at all US airports. The forecast growth for the U.S. aviation industry and the ever-increasing risk of aircraft accidents due to wildlife strikes, require new strategies and great effort in order to continuously improve aviation safety. Involving pilots in this process is not an option anymore, it is a requirement. Providing pilots, through specific ADM training using VR technologies, with the knowledge and skills to mitigate the risk of bird strikes, could reduce the number of human fatalities and injuries due to bird strikes, reduce direct and indirect costs associated with damaging strikes, and support the sustainable growth of the U.S. aviation industry.

References

1. Dolbeer, R. A., & Begier, M. J. (2019). *Wildlife strikes to civil aircraft in the United States: 1990–2017* (Serial Report Number 24). Retrieved from the Federal Aviation Administration website: https://wildlife.faa.gov/downloads/Wildlife-Strike-Report-1990-2017.pdf
2. Federal Aviation Administration (FAA). (2016). *Pilot's handbook of aeronautical knowledge*. Retrieved from https://www.faa.gov/regulations_policies/handbooks_ manuals/aviation/phak/ Federal
3. Federal Aviation Administration (FAA). (2019). *FAA aerospace forecast: Fiscal years 2019-2039*. Retrieved from https://www.faa.gov/data_research/aviation/aerospace_forecasts/media/FY2019-39_FAA_Aerospace_Forecast.pdf
4. Mendonca, F. A. C., Carney, T. Q., & Fanjoy, R. O. (2018). Enhancing the safety training of GA pilots to reduce the risk of bird strikes: An experimental pilot study. *Journal of Aviation, Aeronautics, and Aerospace, 5*(4), 1-27.
5. Pantelidis, V. S. (2009). Reasons to use virtual reality in education and training courses and a model to determine when to use virtual reality. *Themes in Science and Technology Education, 2*(59-2), 59-70.

Direct all correspondence about this research to Flavio Mendonca. Email: FMENDONC@PURDUE.EDU