NASA continues to seek out innovation that provides unique solutions to difficult problems. NASA iTech was created to not only identify breakthrough technologies that address pressing issues here on Earth, but ones that also hold great promise in overcoming critical space-exploration challenges. All ingenuity is welcome, whether generated by business, academia and government organizations, or by any others who wish to make their leading-edge products and processes known to NASA leadership and agency partners in the private and public sectors.

GermFalcon

Ultraviolet Light-Based Sanitizer

Crisscrossing continents at speeds unimagined just a century ago, globetrotters today measure trips in hours, not weeks. But such rapid air travel can also contribute to the spread of contagion, as viruses and bacteria take hold in human hosts from contact with infected aircraft surfaces, or via tiny airborne droplets that circulate in cabins and are inadvertently inhaled.

Reported outbreaks of serious disease aboard commercial flights include tuberculosis, severe acute respiratory syndrome, influenza, norovirus smallpox, even measles. Germs survive on surfaces, and protocols for routine disinfection are ineffective or nonexistent. With passenger numbers globally projected to grow by more than 6 billion by 2030, the threat from human-borne illness will likewise increase.

A remedy may be at hand. Inventor Dr. Arthur Kreitenberg, a full-time orthopedic surgeon in private practice who holds multiple patents, realized this immense health risk. That's why he created the GermFalcon: a sanitizing robotic device that instantly kills pathogens on airplane surfaces and in the surrounding air. Using only ultraviolet-C (UVC) light, the kind used as a disinfectant in hospitals, the apparatus is no larger than a flight attendant's food and beverage cart. It's mobile, compact and able to navigate airplane cabins with ease.

Figure 1 Fully deployed, the GermFalcon germicidal apparatus can eliminate 99.9% of viruses and bacteria on aircraft cabin surfaces in less than three minutes.

Three-Mode Operation

Between flights, GermFalcon's deployable UVC lamps expose seats and seatbacks, armrests, tray tables, overhead bins, air and media controls, and floors to the decontaminating doses of UVC light. Harmful bacteria and viruses are killed instantly on surfaces and in surrounding air.

The GermFalcon is designed to operate in three modes. In the cabin, both wings extend to treat an entire seating area. In the lavatory, a single extended wing reaches in to disinfect the sink, countertop and toilet. In the galley, both wings retract to aim the GermFalcon's UVC lamps at countertops and the crew workspaces.

The GermFalcon is battery-powered and sanitizes a plane in a matter of minutes. There is minimal labor cost and no need for potentially toxic chemical disinfectants. UVC light is effective because of it's to its ability to disrupt microorganisms' DNA and lethally paralyze all cellular functions.

Ready to Deploy
Kreitenberg believes a GermFalcon could be pre-positioned in every airline terminal – locations that themselves could also benefit from rapid and routine UVC-light decontamination - especially near gates for quick deployment into aircraft once passengers debark.

No Federal Aviation Administration regulations prevent the device from being immediately adopted industry-wide. The GermFalcon's design includes electronic shielding, eliminating any concern that operation would conflict or interfere with critical avionics components. The disinfecting system has secured third-party certification, confirming its ability to deliver (with ease) lethal doses of UVC known to achieve complete destruction of all disease-causing pathogens.

Manufacturing costs are pegged at $50,000 per unit, but leasing and rental options would significantly reduce that expenditure. Parent company Dimer, LLC believes that the economic argument for regular use is strong. Not only would routine disinfection help to prevent (currently inevitable) infections to the next flights' unexpecting passengers, but also to lessen the effects of a potential worldwide pandemic. According to GermFalcon, studies indicate that not addressing this potential pandemic in the network of passenger air travel could put public health at elevated risk and exact a global economic toll measured in the billions of dollars.

GermFalcon operation ranges well beyond commercial flight. The device can be used to decontaminate areas in airports, hospitals, hotels, cruise ships, schools, theaters, arenas and restaurants: essentially, any enclosures and structures that encounter heavy use by the public.

Space Travel Protection
GermFalcon's benefits could extend well beyond its terrestrial base. A smaller variant, the GermRover, has been designed by Kreitenberg specifically for use in human-carrying spacecraft compartments and work areas. The self-propelled device would autonomously sanitize all surfaces, then return and dock to a charging unit.

GermFalcon advisory board member Dr. Leonard Mermel, an infectious disease expert and Brown University professor, is the author of a study that examines the infectious risks posed to human health during prolonged space missions. Exposure to microgravity, radiation and stress alters human immunoregulatory responses, which can, in turn, impair an astronaut's ability to resist new infections or trigger those dormant but still present within the body.

In particular, microgravity affects virulence, growth kinetics, and biofilm formation of potential microbial pathogens. Because such interactions occur in a confined space, there is ample opportunity for heavy microbial contamination to occur.

In the long run, the GermRover, or a similar device based on its technology, could provide full or partial sterilization of entire spacecraft exteriors, especially landers and rovers with life-detection experiments, and for those touching down or traveling to a region where terrestrial microorganisms may survive and grow, or where indigenous life may be present.

Current Status
A winner in the NASA iTech 2018 Cycle III Medical Breakthroughs category, GermFalcon is currently pursuing a number of commercialization opportunities. As proof of concept the company has offered free airliner sterilization to any air carrier that requests it.

More information available: GermFalcon, 2018 NASA iTech Cycle I Forum presentation and NASA iTech.