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UNMANNED HYPERSONIC AIRCRAFT

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INTRODUCTION

As weapons are getting more sophisticated, researchers are trying to build defence weapon systems that can keep pace with the continuously evolving technology. Just as stealth has changed the nature of warfare today, very high speeds are being seen as the next big advancement in the field of aviation. After attaining stability in supersonic systems scientists are aiming towards the next segment of speed, i.e. hypersonic region where speed ranges above Mach 5.The United States Air Force Chief Scientist Mica Endsley announced the target date for the next generation hypersonic aircraft as 2023[1]. This time it will take the form of a 6500 kilometers per hour unmanned strike aircraft known as SR-72. It is by far the most advanced and funded hypersonic aircraft project the country has till date and is the most relevant candidate for the claims made by the US Air Force. Countries such as China and Russia are also developing hypersonic technology because of non-availability of weapons to counteract these systems. The need for hypersonic weapons has emerged because with the evolving air defence weapon technology, speed is the only alternative to escape the influence of such weapons. Hypersonic aviation does not only provide high speed but along with it the capability to cover great distances at that speed[2].

BACKGROUND

SR-72 is not the first hypersonic project. Lockheed Martin with DARPA launched HTV-2 (Falcon Hypersonic Technology Vehicle -2). The aim of the project was to gather data related to three major hurdles in hypersonic aviation i.e. aerodynamics,

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thermodynamic effects and guidance. In December 1964 the US Air Force tested Lockheed Martin SR-71 the fastest air breathing manned aircraft used by the United States Air Force with a speed record of approximately 3.5 Mach[3](a record which holds to date for nearly 4 decades). SR-71 known as Blackbird had its retirement flight in 1990 from Los Angeles to Washington[4]. NASA's X-43A was the first aircraft to reach Mach 10 on November 16, 2004. X-43A used a scramjet engine, which eliminates the need for on-board oxygen, which a rocket engine would have required resulting in a significant increase in weight.

The Pentagon has conducted experimentson unmanned hypersonic aircraft X-51A for years over the Pacific but with very limited success. During its fourth and final flight X-51A in May 2013 reached Mach 5. However it crashed into the Pacific Ocean[5]. The X-51A was a $300 million project[6]conceived in 2004 with the first test being performed in 2009.

SR-72

Hypersonic weapons and aircraft strike targets very quickly, thus increasing the probability of hitting value targets. At such speeds an adversary would have very little time to react. These aircraft coupled with hypersonic missiles can reach any location in any continent within an houror so.SR-72 was officially covered by Aviation Week and Space Technology in November 2013, but the development of hypersonic propulsion systems had already started years before in 2006 by Lockheed Martin in collaboration withAerojetRocketdyne[7].

SR-72 is intended to provethat high speed aircraft are neither overly expensive nor inefficient to operate and maintain. One of the reasons for such claims being the use of ramjet engines with very few or no rotating parts. The aircraft uses the data gained from the tests of HTV-2 which could reach atop speed of Mach 20 leading to a surface temperature of 3500^0F. It uses an integrated propulsion system developed by Lockheed

Martin with AerojetRocketdyne to propel the aircraft from zero to Mach 6. The propulsion system is a turbine based combined cycle propulsion i.e. combination of off the shelf turbine with supersonic compression ramjet air breathing engine. This configuration enables the effective use of ramjet engines which require an additional propulsion system to reach threshold speeds required for ramjets. The turbine provides thrust from takeoff to Mach 3. From Mach 3 to hypersonic speeds ramjet engines are used to generate thrust[8]. The design features a common inlet and exit nozzle for both the turbine and the ramjet engine instead of using separate ducts for the propulsion systems, thus significantly reducing the drag[9]. At such high speeds the aircraft will be virtually invulnerable before reaching their targets.

Even at supersonic speed aerodynamic heating becomes a prime concern. Therefore the skin of the aircraft should be able to handle such drastic changes in temperature. The airframe is suitably designed to sustain high temperatures, effects of aerodynamic heating, aero elasticity and optimized for high performance and affordability.

HURDLES IN DEVELOPING A HYPERSONIC SYSTEM

When travelling at speed more than 5 times the speed of sound every component has to be redesigned so that it can contribute to sustain the integrity of the structure. Concepts, theories and numerical data change drastically at hypersonic speeds and more over these conditions change widely when shifting from one speed phase to another, for example, the aerodynamic centremoves forward with increasing supersonic Mach numbers and gradually moves rearward at hypersonic speeds. When the aerodynamic centre reaches close to centre of gravity of the aircraft, it can cause serious instability issues[10].Hypersonic vehicles require the development of new guidance and navigation system which can steer the plane at such high speeds. At speeds more than supersonic range, heating becomes a serious issue and new materials are required that can sustain

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high temperatures and vibrations. Methods for low noise jet exhaust and developing a totally new kind of propulsion systems, with integrated airframe noise suppression facility are needed[11]. Another major concern is the weapons deployed on hypersonic aircraft as they need to be operational at hypersonic speeds resulting in need for modifying their propulsion systems[12].

CONCLUSION

SR-72 received funding from NASA in 2014 to study the feasibility of unmanned hypersonic aircraft[13]. With ever growing technology, countries and their defence systems need to evolve continuously. Hypersonics will definitely change the essence of modern warfare. Despite the technological challenges that hypersonic aviation poses, the advantages of the craft to navigate and strike at high speeds cannot be overlooked. SR-72 will significantly increase the range of defence parameter of the United States and other countries developing hypersonic aircraft. Not only the United States but many other countries are taking interest in this technology such as Russia and China. The Chinese testing of their hypersonic nuclear missile Wu-14 is a case in point.

(Disclaimer: The views and opinions expressed in this article are those of the author and do not necessarily reflect the position of the Centre for Air Power Studies [CAPS])

End Notes

[1] Sophie Tatum," Hypersonic aircraft to go 5 times the speed of sound," *CNN*, June, 6, 2015, CNN politics, Washington, http://edition.cnn.com/2015/06/05/politics/hypersonic-aircraft-air-force/index.html, accessed on June 16, 2015

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[3] *Wikipedia, The free encyclopedia*, s.v. "SR-71", https://en.wikipedia.org/wiki/Lockheed_SR-71_Blackbird, accessed on June 17, 2015.

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[6] Sophie Tatum," Hypersonic aircraft to go 5 times the speed of sound," *CNN*, June, 6, 2015, CNN politics, Washington, http://edition.cnn.com/2015/06/05/politics/hypersonic-aircraft-air-force/index.html, accessed on June 16, 2015

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[9] Ibid.

[10] Wulter P. Nelms, Jr., and Churles L. Thomus,"aerodynamic characteristics of an all-body hypersonic aircraft configuration at mach numbers from 0.65 to 10.6," NASA Technical Note, NASA TN D-6577, 1971, pp. 5-6.

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