

ENTHUSE: Jet Engine Thrust Surge System

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During adverse weather conditions, phenomena like microbursts and wind shears can delay, cancel or even damage flights. Heavy precipitation can cause a downdraft which can knock an aircraft. And hence it is not safe to fly planes if the airlines detect a microburst or windshear in the near future because modern jet engines are incapable of providing highly responsive additional thrust if such a situation arises. So, the airlines delay flight departures and divert flight landings to other airports. This causes huge economic loss to airlines, which we are trying to reduce.

ENTHUSE is a jet engine thrust surge system based off of water electrolysis that provides additional highly responsive thrust to the aircraft in severe weather conditions while adding a negligible amount of mass to the aircraft.

The system works by collecting water injected into the engines during rain or snow into a small wrap around tank inside the bypass duct called Water Electrolysis Tank (WET), which then uses excess power on the aircraft to electrolyse it into oxygen and hydrogen. This hydrogen can then be supplied into the engine nozzle, where it will burn, increasing the temperature and exhaust velocity of the gas escaping the engine and thus increasing thrust. This thrust can be used to decrease the delay between pilots requesting thrust and thrust being attained, and/or it can be used to augment the maximum producible thrust by the engines if, for example, the aircraft encounters a microburst. By using water collected from the environment before reaching the runway, and by utilising the excess power generated by the aircraft engines that is otherwise not required during this time, ENTHUSE effectively employs existing unused resources available on aircraft to minimize the amount of mass (and thus operating costs) added by it.

Our team has successfully demonstrated water electrolysis and partly demonstrated thrust generation using the prototypes we have designed. We will develop a prototype showing the water collection stage and upgrade our current prototype for demonstration of thrust generation. Finally, once all individual stages are complete, we plan on integrating them all and doing a full test run of the system. We have also developed simulations. Demonstrations: [Video 1](#) (Water Electrolysis) | [Video 2](#) (Thrust Generation)

We have developed a Python script that simulates in real time, the operation of ENTHUSE. The script uses a nominal thrust curve representative of current engines to model the thrust from the engines unaffected by ENTHUSE, and then uses a Proportional Integral - Proportional Derivative (PI-PD) control algorithm to manage hydrogen flow such that the required amount of thrust is reached and maintained as soon as possible. Simulation: [Video](#)

We attended the Innovation Summit to pitch our idea in front of a panel of technical experts and investors in April, 2019. We won the competition, and were declared the 'Pete Conrad Scholars' by the Conrad Foundation.