EDF Afterburner

Introduction: An EDF (Electronic ducted fan) is a propulsion arrangement where a mechanical fan is mounted in a cylindrical duct. An afterburner adds heat to a gas flow by burning fuel to increase thrust. An EDF afterburner is therefore an arrangement where an afterburner is used alongside a mechanical fan to achieve increased net thrust.

Motivation: As we try to reduce our dependenceon fossil fuels, most of our modes of transport will eventually switch to using renewable sources of energy. However, most of these renewable sources of energy cannot be used directly, and are converted to and stored as electrical energy.

Therefore, it is safe to assume that most of our modes of transport in the future, including our aircraft, will be powered by electricity. Unfortunately, electric motors by themselves are not yet powerful enough to power our aircraft. We believe we can use the EDF Afterburner as a bridge between conventional jet engines and the electric motors that will replace jet engines in the near future.

Design:
The major challenges in designing will be -

- Designing the propeller
- Determining optimal fuel mass flow rate and distribution of fuel injection
- Determining dimensions of nozzle and duct

Basic construction idea -

- We will use a custom designed propeller to maximize back pressure, and thereby maximize afterburner performance. These propellers will be 3D printed. We will use used canisters for our duct since most aerosol cans are of the diameter we need for our duct.
- The brushless motor, ESC and battery combo will be dependent on the range of pressures we need to create in the duct.
- We will use butane for our fuel. Butane tanks are easily available and are also very safe to use. The fuel injection will be controlled by a servo.

Parts for construction

- 3D Printed propeller - Rs 250
- Glow plug - Rs 250
- Stainless steel tube for duct (Like a used canister)
- Stainless steel tube for afterburner duct
- Aluminium tube for fuel pipe
- Brushless Motor - Rs 1250
- Electronic speed controller for electric motor - Rs 500
- Lipo battery for electric motor - Rs 1200
- Butane gas tank (Used in some torch lighters) - Rs 1000
- Servos for controlling gas flow - Rs 500
- Other miscellaneous parts like screws, tapes and tubes - Rs 2000
- A transmitter and receiver will also be required to control the motors and servos.

Approximate total cost - Rs 7000

Timeline:

Week 1:

- Design propellers and print them
- Use propellers with motors we already have in a sample duct (maybe a cardboard tube) to work out the effect on back pressure and gas flow velocity of propeller shape and size, motor speed, duct diameter .
- Simultaneously design fuel system. This will be independent of the EDF because if we're using commercial butane tanks there will not be a lot of parameters we can tune.
- Order new electric motor in case initial data shows that we can improve performance by doing so.

Week 2:

- Continue gathering data
- Complete fuel system
- Finalize EDF system based on data gathered in the previous 2 weeks

Week 3:

- (Orders made online should be delivered by now)
- Start building final EDF which will have a metal duct
- Integrate EDF and fuel system
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Weeks 4 and 5:

- Serve as buffer weeks in case orders are delayed
- Other minor changes can be made to optimize performance

In case we do not have enough data by week 2, work in the following weeks will be postponed by at most a week to gather more data.