Short Take-off & Landing for Unmanned Aerial System

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Short Takeoff and Landing: (DOD/NATO) The ability of an aircraft to clear a 50-foot (15 meters) obstacle within 1,500 feet (450 meters) of commencing takeoff or in landing, to stop within 1,500 feet (450 meters) after passing over a 50-foot (15 meters) obstacle. This method is also known as STOL.
Benefits of STOL

Quick flow of airport traffic
More accessible locations for aircraft
UAV Mission Capabilities

[Images of UAVs and ships]
Methods used to achieve STOL

- Wing Modification
- Thrust Modification
- Other Methods
Wing Modification

* Flaps
* Slats
* Vortex Generators
* Winglets
Thrust Modification

- Thrust Reversers
- Variable Pitch Propeller
- Rocket Boosters
Other Methods

- Airbrakes
- Wheel Breaks
- Parachute
The UA V will perform as simple flight layout. This will be a simple loop in the shape of the test field.

The crucial data required out of the mission is the distance of takeoff and landing.

The data will be recorded using an on-board computer.
Software Design

Simulation and Flight Testing
# Airframe for Short-Landing Testing

## Sig-72 Airframe

<table>
<thead>
<tr>
<th>Specification</th>
<th>Metric 1</th>
<th>Metric 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wingspan</td>
<td>72 in</td>
<td>1829 mm</td>
</tr>
<tr>
<td>Wing Area</td>
<td>720 in²</td>
<td>46.5 dm²</td>
</tr>
<tr>
<td>Length</td>
<td>51.75 in</td>
<td>1315 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>5 - 5.5 lbs</td>
<td>2268 - 2495 g</td>
</tr>
<tr>
<td>Radio Required</td>
<td>4-Channel with 5 Standard Servos</td>
<td></td>
</tr>
<tr>
<td>Glow Power</td>
<td>2-Stroke .40-.46 cu. in. (6.5-7.5 cc) 4-Stroke .40-.54 cu. in. (6.5-8.8 cc)</td>
<td></td>
</tr>
<tr>
<td>Electric Power</td>
<td>500 - 800 watt (800 - 1000 kv) Brushless Motor; 50 - 60A ESC; Lipo Battery Pack</td>
<td></td>
</tr>
</tbody>
</table>
Simulation Environment

Load Data  Edit M-File  Real Time

Version 1.1
7/31/2012

Manual Flight

Sig 72 Aerodynamic Model

No Turbulence

Sensors

Signals

Data Manager

FlightGear

FlightGear Data Manager
Simulation Environment

6DOF Aerodynamic Model
**Fast Prototyping of On-board System**

**Ardupilot APM2.5**

- APM 2.5
- Magnetometer
- GPS
- IMU
- Pressure Sensor
- Analog Inputs
- Barometric Sensor
- RC Channels
- Telemetry
- Flash Memory

New wireless telemetry port

More robust USB port connector

Extra status LED

3-Axis Gyro

3-Axis Accel

Pressure Sensor

New style GPS port

Optional to use external magnetometer

On board Mag

Dataflash

New External I2C port

New fuse

New diode

Power port

Measure Vcc here
Fast Prototyping of On-board System

**Software**

**Real-Time Workshop**

**C++ Compiler**

**APM 2.0**

**Ardupilot**

**ERAU Support Blockset**
Fast Prototyping of On-board System

Software

![Function Block Parameters: 6-DOF IMU](image)

- **Arduino IMU (mask) (link)**
  - This block reads from the ArduPilot 2.0 inertial measurement unit.
  - Filter must be set to 1/2 or less of base sample rate.
  - Resolution versus range, etc.
  - Inputs are to pass through data when in simulation mode. They are not used for embedded purposes.

**Parameters**

- **Low Pass Filter Frequency**: 20 Hz
- **Max Gyro Scale**: $\pm 500$ deg/sec
- **Max Accelerometer Scale**: $\pm 8g$
- **Sample Time**: `ts_arduino_claw`
Fast Prototyping of On-board System

**Software**

![Function Block Parameters: GPS](image)

- Latitude (deg)
- Longitude (deg)
- Altitude (ft)
- Ground Speed (ft/sec)
- Ground Course (deg)
- Num of Satellites
- Fix Type
- UTC Date
- UTC Time (ms)
- HDOP (ft)

- ArduPilot Mega 2.0
- MediaTek MT3329 GPS Unit (mask) (link)

UTC_Time, ms from midnight, UTC
UTC_Date, DDMMYY, UTC

Fix Type:
0 = No GPS Unit
1 = GPS Unit, no lock
2 = GPS unit, locked

Inputs used only for simulation, yada yada yada
Fast Prototyping of On-board System

Software
Fast Prototyping of On-board System

**Hardware**

- RC-Remote
- RC-Receiver
- Servos and Motor
- Ground Station
- Tx
- Pitot Tube
Fast Prototyping of On-board System

Motor Test-bed
The Academy of Model Aeronautics’ (AMA) Daytona Beach field was chosen for the flight test program. Approximately 1400 ft long and 1300 ft wide, the field has enough space to perform the necessary maneuvers. It has a single, hard-surface runway located on the east side. Figure 5 shows a satellite image of the field.
Preliminary Flight Data

Touchdown
- High Frequency signal after touch down
Preliminary Flight Data

Flight State On-boar signal

Touchdown - High Frequency signal after touchdown

Activate brakes control and heading control
Questions