Short Take-off & Landing for Unmanned Aerial System

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What Is Short Take-Off and Landing (STOL)

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
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
**Sig-72 Airframe**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
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<tbody>
<tr>
<td><strong>Wingspan:</strong></td>
<td>72 in 1829 mm</td>
</tr>
<tr>
<td><strong>Wing Area:</strong></td>
<td>720 in² 46.5 dm²</td>
</tr>
<tr>
<td><strong>Length:</strong></td>
<td>51.75 in 1315 mm</td>
</tr>
<tr>
<td><strong>Weight:</strong></td>
<td>5 - 5.5 lbs 2268 - 2495 g</td>
</tr>
<tr>
<td><strong>Radio Required:</strong></td>
<td>4-Channel with 5 Standard Servos</td>
</tr>
<tr>
<td><strong>Glow Power:</strong></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>
</tr>
<tr>
<td><strong>Electric Power:</strong></td>
<td>500 - 800 watt (800 - 1000 kv) Brushless Motor; 50 - 60A ESC; Lipo Battery Pack</td>
</tr>
</tbody>
</table>
Simulation Environment

6DOF Aerodynamic Model

Landing Gear 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 External I2C port
Optional to use external magnetometer
On board Mag
Dataflash
Old style GPS port
New style GPS port

Measure Vcc here
New diode
New fuse
Power port
Fast Prototyping of On-board System

**Software**

- Real-Time Workshop
- C++ Compiler
- ERAU Support Blockset

![MATLAB SIMULINK](image)

APM 2.0 Ardupilot
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**: +/- 500 deg/sec
- **Max Accelerometer Scale**: +/- 8g
- **Sample Time**: ts_arduino_claw

![8-DOF IMU](image)
Fast Prototyping of On-board System

**Software**

![Function Block Parameters: GPS](image)
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Software
Fast Prototyping of On-board System

**Hardware**

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

Motor Test-bed
Fast Prototyping of On-board System

**Flight Testing**

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-board signal

Touchdown
- High Frequency signal after touch down

Activate brakes control and heading control
Questions