3. Take-off and landing

*or how much runway do we need?*

G. Leng, ME Dept, NUS
The FAR take-off sequence

- Engine failure at $V_1$
- Lift-off distance
- Runway
- Stop distance
- Stopway
- Takeoff field length

G. Leng, ME Dept, NUS
The FAR landing sequence

G. Leng, ME Dept, NUS
Example of a take-off climb

Silkair 737-300B taking off from Changi Airport

G. Leng, ME Dept, NUS
Example of a civilian runway

- Changi airport runway is long and wide
- Cleared for Code F aircraft (A380) ops
- Wing span measuring < 80m
- Outer main gear wheel span < 16m

G. Leng, ME Dept, NUS
Take-off and landing field lengths - civilian

<table>
<thead>
<tr>
<th>A380-800</th>
<th>Boeing 747</th>
</tr>
</thead>
<tbody>
<tr>
<td>take-off field length</td>
<td>2990 m (9810 ft)</td>
</tr>
<tr>
<td>landing field length</td>
<td>2103 m (6900 ft)</td>
</tr>
</tbody>
</table>

G. Leng, ME Dept, NUS
Take-off field lengths - military

<table>
<thead>
<tr>
<th></th>
<th>MTOW (klb)</th>
<th>TOFL (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T45</td>
<td>15</td>
<td>2250</td>
</tr>
<tr>
<td>AV8B</td>
<td>32</td>
<td>2600</td>
</tr>
<tr>
<td>E2C</td>
<td>53</td>
<td>2100</td>
</tr>
<tr>
<td>S3</td>
<td>53</td>
<td>3500</td>
</tr>
<tr>
<td>EA-6B</td>
<td>61.5</td>
<td>4010</td>
</tr>
<tr>
<td>F18E/F</td>
<td>66</td>
<td>3680</td>
</tr>
<tr>
<td>F14</td>
<td>72</td>
<td>4600</td>
</tr>
<tr>
<td>P3C</td>
<td>140</td>
<td>4600</td>
</tr>
<tr>
<td>C130</td>
<td>173</td>
<td>5580</td>
</tr>
</tbody>
</table>

G. Leng, ME Dept, NUS
Military take off / landing

F15 - scramble

C130 – jet assisted take off

G. Leng, ME Dept, NUS
Military runways

G. Leng, ME Dept, NUS
STOVL - Short takeoff and vertical landing

DOD, NATO’s definition:
Fixed-wing aircraft capable of clearing a 15-meter (50-foot) obstacle within 450 meters (1500 feet) of commencing takeoff run, and capable of landing vertically.

Joint Strike Fighter – vertical landing

G. Leng, ME Dept, NUS
ESTOL – Extremely short takeoff and landing