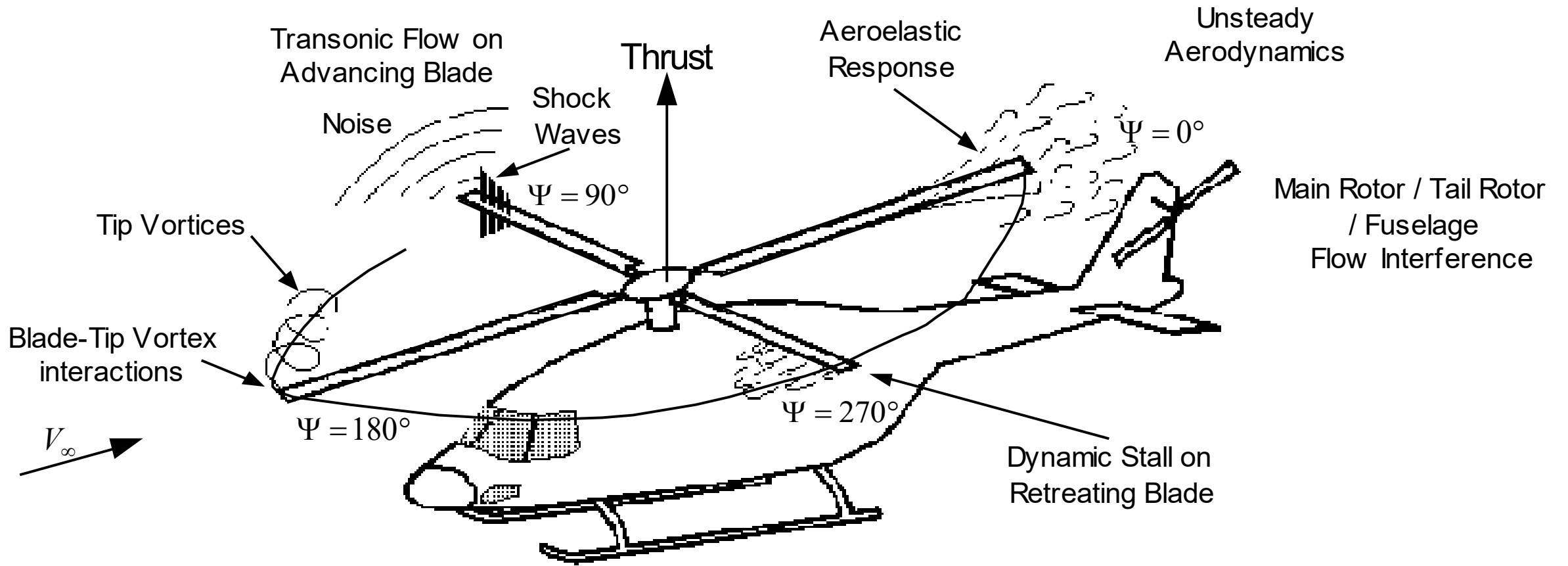


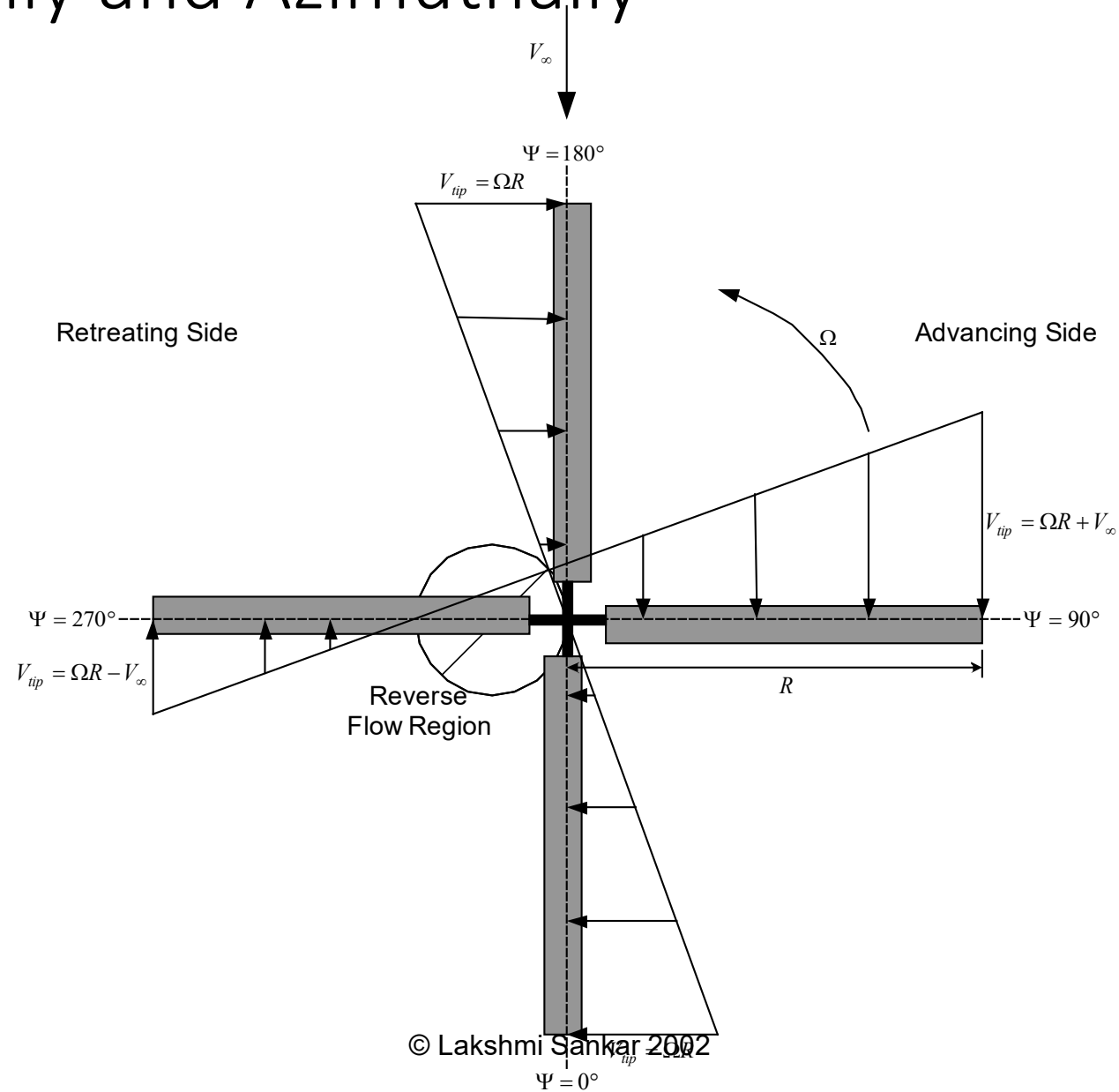
Steady, Level Forward Flight

I . Introductory Remarks

The Problems are Many..



The Dynamic Pressure varies Radially and Azimuthally



Consequences of Forward Flight

- The dynamic pressure, and hence the air loads have high harmonic content. Above some speed, vibrations can limit safe operations.
- On the advancing side, high dynamic pressure will cause shock waves, and too high a lift (unbalanced).
 - To counter this, the blade may need to flap up (or pitch down) to reduce the angle of attack.
- Low dynamic pressure on the retreating side.
- The blade may need to flap down or pitch up to increase angle of attack on the retreating side. This can cause dynamic stall.
- Total lift decreases as the forward speed increases as a consequence of these effects, setting a upper limit on forward speed.

Forward Flight Analysis thus requires

- Performance Analysis – How much power is needed?
- Blade Dynamics and Control – What is the flapping dynamics? How does the pilot input alters the blade behavior? Is the rotor and the vehicle trimmed?
- Airload prediction over the entire rotor disk using blade element theory, which feeds into vibration analysis, aeroelastic studies, and acoustic analyses.
- We will look at some of these elements.