Synopsis of RotorGen2 Simulator Math Model

The original purpose of *RotorGen* math model development was to provide a minimal-complexity, first-principles representation of a rotorcraft with the ability to reconfigure easily using rational geometric and mass features.

Each of the model components is designed to balance simplicity and model fidelity. Empirical adjustment of parameters is made as required to match to available validation data.

The current model, *RotorGen2*, is a refinement of the "minimal-complexity" helicopter math model developed under an Army Aeroflightdynamics Directorate contract. A desktop computer version includes vehicle model along with pilot and ADS-33 demonstration maneuver models.

• Rotor model based on Glauert's R&M 1111 representation giving rotor forces and induced velocity as functions of translational velocity components and hub controls (cyclic, collective).

-constant axial flow thru disk

-lift on blade proportional to incidence

-flapping expanded as Fourier series (harmonics neglected)

-squares and higher powers of advance ratio neglected

• Tip path plane model based on quasi-static formulation of Chen's NASA TP 1431 flapping equations.

-flapping angles are functions of cyclic, angular rates, and translational velocities.

-tip path plane defined by flapping angles resolved in body frame.

• Body forces and moments based on classical *quadratic aero model* form of Horace Lamb.

-selected terms applicable to broad flight regime.

-downwash on fuselage neglected.

-can describe airfoil and bluff-body aero effects.

• Tail rotor based on momentum theory to compute thrust and power required.

• Torque-required based on buildup of power-required components (induced, profile, parasite, climb, transmission loss) as used by Wood's MCEP model.

-feedback of rpm and torque to represent 2^{nd} order governing effect.

•Simple generic SCAS forms are available with same level of simplicity as rotor and body aero models.

-Response modes include rate-command, attitude-command, and translational-rate-command

•Several rotorcraft modeled for various applications.

-CH-47, CH-53, UH-1, MD-500, Bo105, CH-47, AH-1, UH-60, A-109

-Matlab/Simulink model adapted from original Fortran application

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