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helicopter; 1.4. Gyroscopic effects; 1.4.1. Forward or backward motion; 1.4.2. Equations of motion; 1.4.2.1. Natural angular frequencies (shaft off motion) 1.4.2.2. Critical speeds during forward precession 1.4.2.3. Critical speeds during retrograde precession; Chapter 2. Piston Engines; 2.1. Introduction; 2.2. Excitations generated by a piston engine; 2.2.1. Analytic determination of an engine torque; 2.2.2. Engine excitations on the chassis frame; 2.2.2.1. Knocking load; 2.2.2.2. Pitch torque; 2.2.2.3. Review of actions for a four phase cylinder engine; 2.2.3. The notion of engine balancing; 2.2.3.1. Balancing the knocking loads; 2.2.3.2. Balancing the galloping torque; 2.3. Line shafting tuning; 2.3.1. The notion of tuning 2.3.2. Creation of the equations 2.3.3. Line shafting optimization; 2.3.3.1. Results for a non-optimized line shafting; 2.3.3.2. Results for an optimized line shafting; Chapter 3. Dynamics of a Rotor; 3.1. Introduction; 3.2. Description of the blade/hub relationship; 3.2.1. Some historical data; 3.2.2. Hinge link of the blade and the hub; 3.2.2.1. Formation of the equations for blade motion; 3.2.2.2. Homokinetic rotor; 3.3. Rotor technologies; 3.3.1. Articulated rotors; 3.3.1.1. Conventional articulated rotors; 3.3.1.2. Starflex® and Spheriflex® rotors; 3.3.2. Hingeless rotors 3.3.3. Hingeless rotor 3.4. Influence of alternate aerodynamic loads; 3.4.1. Load characterization; 3.4.1.1. Loads on a blade; 3.4.1.2. Dynamic response of a blade; 3.4.1.3. Loads transmitted by a mode i; 3.4.2. Analysis of loads transmitted to the rotor hub; 3.4.2.1. Loads transmitted to the rotor; 3.4.2.2. Synthesis of rotor loads on the rotor mast; 3.4.3. Dynamic optimization of a blade; 3.4.3.1. Introduction; 3.4.3.2. Study of the example of an optimized blade; 3.4.3.3. Contribution of the second flapping mode; Chapter 4. Rotor Control; 4.1. Introduction; 4.2. Blade motions 4.2.1. Flapping equation - general case

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## Sommario/riassunto

For all rotational machines, the analysis of dynamic stresses and the resulting vibrations is an important subject. When it comes to helicopters and piston engines, this analysis becomes crucial. From the design of parts working under stress to the reduction of the vibration levels, the success of a project lies mainly in the hands of the dynamicists. The authors have combined their talents and experience to provide a complete presentation on the issues involved. Part one describes, in concrete terms, the main dynamic phenomena and how they can be observed in reality. Part two presents infor

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