Chapter 4
Innovative Rotor Blade Design Code

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Abstract The competitive advantage in helicopter world market is to develop a rotor design ‘tailored’ on specific, more demanding performances such as higher cruise speed and higher cruise altitude, but, at the same time, guaranteeing the maximum level of comfort for the crew and the passengers. To achieve this goal, it is normal practice to apply some design rules to the rotor aeromechanic behaviour but the residual hub loads transferred to the supporting pylon can still be so high that, in order to meet the desired threshold of the vibratory level, some vibration absorbers have to be installed as well. The reason for this has been up to now the poor to weak prediction capability of the vibratory rotor loads due to the incomplete knowledge in the rotor wake modelling and in the aerodynamics and structural interactions which are the sources of vibratory forces.

To overcome these difficulties AW has developed a new aeroelastic code, called GYROX II, FEM based, capable of representing any complex blade shape and hub/control system/pylon features. Details of the code, together with several results of the application of the code to twin-engine light-medium helicopters, are presented. Short- and medium-term upgrading of the code in order to become more attractive design tools in an integrated aeromechanics and flight mechanics environment is finally faced.
4.1 Introduction

Today helicopter world market assets, following the recent significant expansion of the usage of such a vehicle, can be identified in the level of productivity and comfort of the offered class of products.

The word productivity is well expressed by the product of the payload and the maximum speed achievable or, alternatively, the range covered; the improvement of any of these parameters, leaving the other unchanged, is leading to a better productivity (Fig. 4.1).

An improvement of the productivity can be furthermore achieved by expanding the type of mission profile which can be flown: in this sense a tiltrotor (Fig. 4.2), doubling the maximum cruise speed and flying, like a turboprop, at higher cruise altitude (7500 m), but, like an helicopter, not requiring more than a small vertiport to takeoff and land, is going to offer a very attractive platform ‘point to point’ mission.

But the achievement of the target above cannot be claimed if the design of the vehicle is not improved as well in terms of vibroacoustic comfort and exterior noise produced.

The vibratory level, generated mostly by the main rotor, has to be minimized at any speed, both in the cockpit area, to reduce the required skill of the pilot and

![Fig. 4.1 A109E helicopter](image1)

![Fig. 4.2 BA609 tiltrotor](image2)