Chapter 17
Impact-Resistant Flying Platform for Use in the Urban Construction Monitoring

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ABSTRACT

A case study drone that constitutes a shock-resistant aerial vehicle is discussed in the chapter. The aerial motor platform is placed in gimbal joints of the exclusive framework (shell). The platform is a helicopter type aerial vehicle powered with two coaxial rotors of contra rotation. Mathematical model of the platform spatial dynamics bases Lagrange's equations to bring reliable solutions so that advanced model-based control law design techniques can be used. Though the case study implies utilizing an automatic flight mode of the aerial vehicle, it can be piloted remotely on radio. The on-board video cameras and other sensors are used to bring about both navigational duties and surveillance missions such as building constructions monitoring.

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BACKGROUND

This chapter presents urban grow concerns and trends and how unmanned aerial vehicle can help solve these difficulties.

Unmanned aerial vehicle (UAV) is a small-size air flight vehicle controlled remotely or flying automatically. A number of advantages of this vehicle compared to other traditional ones gave rise to their intensive expansion into practical civilian applications. They are successfully used in geodesy and mapping, monitoring the state of urban infrastructure, transport communications, engineering networks for various purposes, also monitoring environmental changes and warning emergency in engineering structures, impending natural hazards, and in a number of other areas.

Sociological studies on urbanization indicate that by now 55% of the world's population lives in cities (Kucharczyk & Hugenholtz, 2018) and by 2050 it may increase to 68% (Mohammed et al., 2014), the unprecedented urban population growth. So, in 1800, only 2% of people lived in cities. In 1950, only 30% of the world population was considered a city dweller. Every year almost 180 thousand people move to the cities. In developing countries, the urban population is replenished by 60 million people. This rate of the urban population growth, according to experts, will continue during the next 30 years (Jensen, 2016).

Intensive rate of the urban population growth has led to the emergence of a number of applied and scientific problems of stable urban development (Gallacher, 2016). According to the Director of the Earth Institute at Columbia University, Jeffy Sachs, cities around the world should move in three strategic directions that ensure acceptable living conditions for all residents of the city (Kucharczyk & Hugenholtz, 2018):

1. Urban planning, which includes well-designed water supply, sewerage and recycling systems, as well as public transport and health care systems;
2. City development strategy, i.e. setting goals taking into account the conditions of the region;
3. Effective city management.

The rapid growth of the urban population leads to an increase in the relevance of the problem of effective urban management (Gevaert et al., 2018). For a productive solution to this problem, several concepts have been proposed. The most popular and requested concept seems to be the formation of smart cities using UAVs. (Krieger et al., 2018). Mobility, low cost and ease of operation of UAVs allow using them as carriers of different types of sensors (Germen, 2016) that supply information to the urban control center about the technical condition of the urban infrastructure (Jensen, 2016).