Institute of FIeld roBOtics (FIBO)

A Cradle of Future Leaders in Robotics

Power Based Lyapunov Function Autonomous Helicopter

Researcher : Dr . Annop Ruangwiset and Mr . Thapanasak Thongsuwan

UP to now, various researches about UAV have been made with using knowledge of various areas. A widely interested area is the automatic control. The object of this paper is to develop an stabilization augmented control of helicopter which based on the concept of mechanical energy. The developed controller is expressed in the form of Rayleigh's energy dissipation with automatic adjustment in accordance to each conditions of the system. However, the difficulty in controlling helicopters lies in highly nonlinear dynamics, strongly couple and relate between variations which are present in the model .

Figure.1 FIBO Helicopter

This research shows the effectively use of physical properties of the system in the design of controller, and shows that the stability of mechanical system depends on the derivative gain (K_d). mechanical power, i.e. the time derivative of energy, is considered in the design of controller.

In this paper, the mechanical power of the system was considered in the design of stability augmented controller for helicopter to maintain hovering flight. The function of power vector of the system was divided into 2 parts. The first one is the internal power vector which is produced by internal forces, i.e. the power of the system. The second part is the external power vector which is produced by external forces. This part is the result of control forces, and is called "Artificial Power Vector". In this work, the stability of the helicopter was considered as the condition that the summation of the moment in all axes are zero. The artificial power vector was considered separately in each axis, because the property of the vector would be used to represent the stability. In addition, the resulted artificial power vector must not stall the helicopter.

In this work, the model of X-cell 60 helicopter was used by referring the value of variable. The numerical simulation of the helicopter was constructed to verify the capacity of our proposed control method

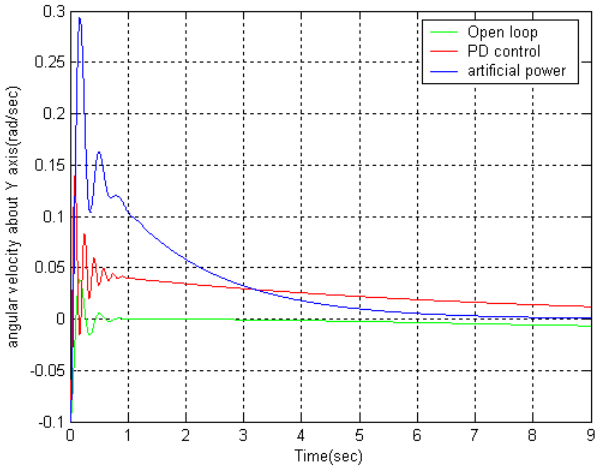

Figure 2. Roll velocity(roll=18 deg, pitch=-18 deg)

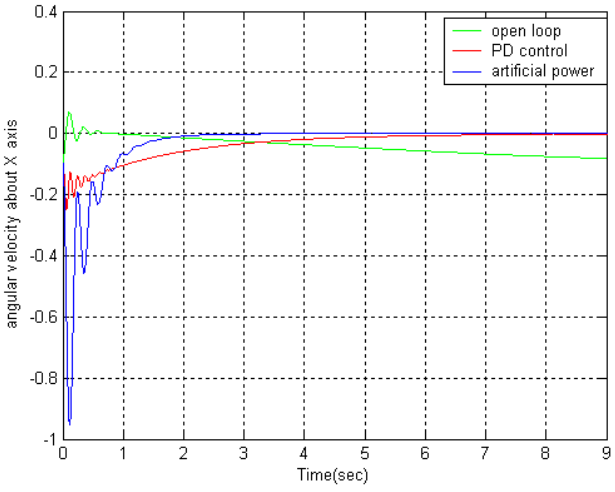

Figure 3.Pitching velocity(roll=18 deg ,pitch=-18 deg)