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A Study of Individual Body Weight Prediction using Kalman Filter

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Abstract. This paper proposes an individual body weight prediction method using Kalman filter. The basic aim behind the idea of human body weight prediction is to predict and diagnose individual lifestyle diseases such as diabetes, high blood pressure and obsess. These lifestyle diseases are usually causes by the increase in human body weight. Human body weight is a best estimator of lifestyle diseases. In this paper we are considering a series of human body weight data of an American man whose height is 191cm and age is between 30~40 years. We predict the human body weights for different duration throughout the year and analyze the efficiency of the prediction algorithm.

Keywords: Individual body weight prediction, Kalman filter, Lifestyle diseases, Health care.

1 Introduction

In common, health care systems provide healthcare services, including screening examinations, prenatal care and infectious disease control. Presently, busy lifestyles including hard work in everyday business can cause rise in chronic disease. Examples of chronic disease comprise the lifestyle diseases. The lifestyle diseases are known as diabetes, high blood pressure and high blood sugar. These diseases are caused by smoking, alcohol drinking, and fatness which leads to increase in human body weight. Daily healthcare is needed for preventing the lifestyle disease. To prevent these diseases, health care system for healthy people receives much considerable attentions.

In this connection several works have been carried out to bring awareness regarding lifestyle diseases. In [1], authors pointed that “More than 1 billion people around the world are overweight, and at least 300 million of those are clinically obese. Without action, more than 1.5 billion people are expected to be overweight by 2015.” Thus, human body weight control is very important to avoid lifestyle diseases in this busy world. In [2], authors proposed and consider a personal health system to control body weight of individual personal. They proposed a system which collects daily

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body weight information and analyzes them. It finally gives an advice to the patient's to control the body weight. In [1], the main goal of the proposed system is to empower individuals and patients to better manage their health by providing them with information regarding their fitness and health through personal medical devices and services. The Fuzzy-autoregressive (AR) model [3, 7] proposed has a fuzzy membership function. The fuzzy membership function controls the magnitude of the coefficient added to maximum AR parameter in autoregressive (AR) model [8-10].

In this study, we propose a prediction method of human body weight for one week using Kalman filter. The Kalman filter is a recursive filter that is based on the use of state space techniques and recursive algorithms. It estimates the state of a dynamic system. This dynamic system can be disturbed by some noise, mostly assumed as white noise. To improve the estimated state the Kalman filer uses measurements that are related to the state but disturbed as well. Kalman filter consists of two steps, prediction and correction.

2 Prediction of body human weight using Kalman filter

A Kalman filter is one of the optimal estimators; it infers parameters of interest from indirect, inaccurate and uncertain observations. It is recursive so that new measurements can be processed as they arrive. The Kalman filter addresses the general problem of trying to estimate the state x∈Rn of a discrete-time controlled process that is governed by the linear stochastic difference equation.

$$X_k = A_{x(k-1)} + B + w_{(k-1)} \quad (1)$$

With a measurement z∈R^n

$$Z_k = H_{x(k)} + v_k \quad (2)$$

The random variables and represent the process and measurement noise (respectively). They are assumed to be independent (of each other), white, and with normal probability distributions.

The process noise covariance Q and measurement noise covariance R matrices are change with each time step or measurement, however here we assume they are constant. The matrix A in the difference equation (1) relates the state at the previous time step k – 1 to the state at the current step k, in the absence of either a driving function or process noise. In practice A might change with each time step, but here we assume it is constant. The matrix B relates the optional control input to the state x. The matrix H in the measurement equation (2) relates the state to the measurement z_k. In practice H might change with each time step or measurement, but here we assume it is constant. The prediction has its effect all the time during the system operation. It is introduced to give enough information's to the health care system to alarm the patient beforehand, so that the possible disease can be prevented. In-fact weight prediction helps physician in diagnosing upcoming diseases for a patient and can easily advised him to change lifestyle.

$$Error = bw - pbw \quad (3)$$

$$Accuracy = (((((Error) + 100) * bw) / pbw) / ((Error) + 100)) * 100 \text{ iff } pbw >= bw \quad (4)$$

where 'bw' means body weight and 'pbw' means predicted body weight. In equation (4) bw and pbw can be interchange if body weight value is greater than its prediction value.

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3 Conclusions

In this paper our aim behind the idea of human body weight prediction is to predict and diagnose of an individual lifestyle diseases such as diabetes, high blood pressure and obsess. These lifestyle diseases are usually causes by the increase in human body weight. Human body weight is a best estimator of lifestyle diseases.

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