

PROCESS CONTROL

Field of Disclosure

[0001] The present disclosure relates generally to process control. More specifically, but without limitation, the disclosure relates to coordinated control systems and methods of controlling an actual process.

Background

[0002] A number of systems and methods are utilized to control various processes, such as industrial processes. Process control may be utilized to satisfy an objective, such as predictability, stability, and/or operating at a desired level. There is continued focus in the industry to providing new and improved control systems and/or methods of controlling a process.

Summary

[0003] According to a first aspect of the present invention, there is provided a method of controlling an actual process, the method comprising: determining a set of projection values for a measured disturbing variable wherein the measured disturbing variable is not actively manipulated to influence an actual primary control variable; determining an actual primary control variable value for the actual primary control variable; determining an estimate of the actual primary control variable value utilizing a first nonlinear dynamic model, wherein the first nonlinear dynamic model utilizes a primary manipulated variable value, a secondary manipulated variable value, and the set of projection values for the measured disturbing variable; determining a primary manipulated variable set point value utilizing a second nonlinear dynamic model, the actual primary control variable value, the estimate of the actual primary control variable value, an actual primary control variable set point value, and the set of projection values for the measured disturbing variable, wherein the primary manipulated variable set point value is utilized to meet a control objective; determining a secondary manipulated variable set point value utilizing a third nonlinear dynamic model, the actual primary control variable value, the estimate of the actual primary control variable value, the determined actual primary control variable value, and the set of projection values for the measured disturbing variable, wherein the secondary manipulated variable set point value is utilized to meet the control objective; and

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providing the primary manipulated variable set point value and the secondary

manipulated variable set point value to the actual process, thereby controlling the actual process.

[0004] According to a second aspect of the present invention, there is provided a non-transitory computer-readable medium storing instructions executable by a processing resource to

determine a set of projection values for a measured disturbing variable wherein the measured disturbing variable is not actively manipulated to influence an actual primary control variable;

determine an actual primary control variable value for the actual primary control variable;

determine an estimate of the actual primary control variable value utilizing a first nonlinear dynamic model, wherein the first nonlinear dynamic model utilizes a primary manipulated variable value, a secondary manipulated variable value, and the set of projection values for the measured disturbing variable;

determine a primary manipulated variable set point value utilizing a second nonlinear dynamic model, the actual primary control variable value, the estimate of the actual primary control variable value, an actual primary control variable set point value, and the set of projection values for the measured disturbing variable, wherein the primary manipulated variable set point value is utilized to meet a control objective;

determine a secondary manipulated variable set point value utilizing a third nonlinear dynamic model, the actual primary control variable value, the estimate of the actual primary control variable value, the actual primary control variable set point value, and the set of projection values for the measured disturbing variable, wherein the secondary manipulated variable set point value is utilized to meet the control objective; and

provide the primary manipulated variable set point value and the secondary manipulated variable set point value to the actual process, thereby controlling the actual process.

[0005] According to a third aspect of the present invention, there is provided a coordinated control system comprising: an actual process associated with an actual primary control variable; a primary controller that controls a primary manipulated variable that influences the actual primary control variable, wherein the primary controller provides a primary manipulated variable set point value to the actual process; a secondary controller that controls a secondary manipulated variable

that influences the actual primary control variable, wherein the secondary controller provides a secondary manipulated variable set point value to the actual process; an estimate of process that utilizes a nonlinear dynamic model to determine an estimated primary control variable value, wherein the nonlinear dynamic model utilizes the primary manipulated variable value, the secondary manipulated variable value, and a measured disturbing variable value; and a projection of the measured disturbing variable that provides a set of projection values for the measured disturbing variable to the primary controller and the secondary controller, wherein: the primary controller determines a primary manipulated variable set point value to be presently effectuated; the primary manipulated variable set point value is utilized to meet a control objective; and the secondary controller determines a secondary manipulated variable set point value to be presently effectuated.

[0006] The above summary of the present disclosure is not intended to describe each disclosed embodiment or every implementation of the present disclosure. The description that follows more particularly exemplifies illustrative embodiments. In several places throughout the application, guidance is provided through lists of examples, which examples can be used in various combinations. In each instance, the recited list serves only as a representative group and should not be interpreted as an exclusive list.

Brief Description of the Drawings

[0007] Figure 1 is an illustration of an example of a coordinated control system in accordance with one or more embodiments of the present disclosure.

[0008] Figure 2 is an illustration of an example of a nonlinear dynamic model in accordance with one or more embodiments of the present disclosure.