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ABSTRACT

METHOD FOR DETERMINING FUNCTION PARAMETERS FOR A CONTROL UNIT

The present subject matter describes a method for determining function parameters (20, 42) for a control unit (22), which is provided for actuating a technical system (10, 30). At least one target variable is predefined for a system behavior and a variation of the function parameters (20, 42) is carried out. From a received response to the function parameters (20, 42), an evaluation of the set function parameters (20, 42) is carried out taking into account the at least one predefined target variable.

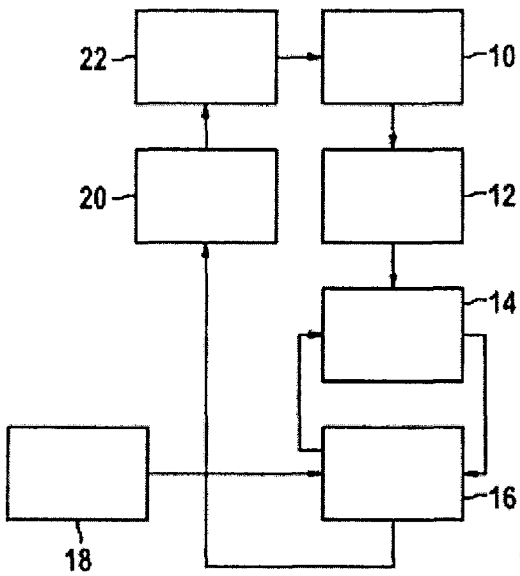

Fig. 1

I/We claim:

1. A method for determining function parameters (20, 42) for a control unit (22), which is provided for actuating a technical system (10, 30), the method comprising:

predefining at least one target variable for a system behavior;

carrying out a variation of the function parameters (20, 42); and

from a received response to the function parameters (20, 42), carrying out an evaluation of the set function parameters (20, 42) taking into account the at least one predefined target variable.

2. The method as claimed in claim 1, wherein the function parameters (20, 42) are varied directly on the system (10, 30) and the response is a response of the system (10, 30).

3. The method as claimed in claim 1, wherein the function parameters (20, 42) are varied via an intermediate model (32) and the response is a response of the intermediate model (32).

4. The method as claimed in any one of claims 1 to 3, wherein the method further comprises calculating a model (14, 36) of the system (10, 30) for the at least one predefined target variable from a response criteria and from a calculated criteria.

5. The method as claimed in any one of claims 1 to 4, wherein an optimizer (16, 38) is used.

6. The method as claimed in claim 5, wherein the optimizer (16, 38) considers a development of responses.

7. The method as claimed in any one of claims 1 to 6, wherein the method further comprises defining the number of target variables and the system behavior via a weighting of the target variables.

8. The method as claimed in any one of claims 1 to 7, wherein the method is carried out within a control unit software.

9. The method as claimed in any one of claims 1 to 7, wherein the method is carried out outside a control unit software.

10. A control unit (22) having a computing unit for carrying out the functions of a system, wherein the control unit (22) is adapted to determine the function parameters (20, 42) of the functions with a method as claimed in any one of claims 1 to 9.

Dated this 16th day of April 2012

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To
The Controller of Patents
The Patent Office at New Delhi

Applicant(s) Name: **ROBERT BOSCH GmbH** Sheet No.: 1

Application No.: Total No. of Sheets: 1

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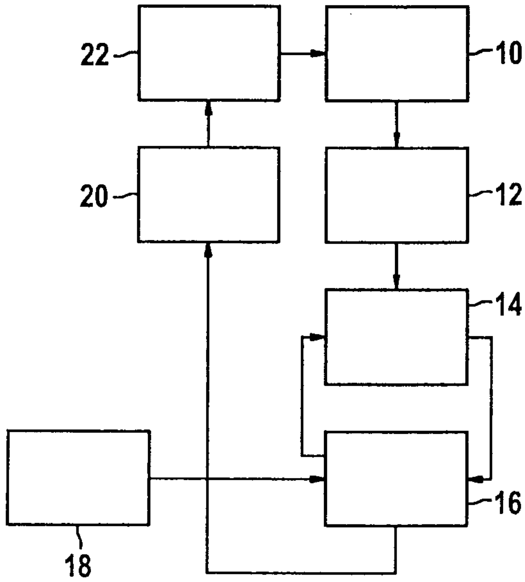

Fig. 1

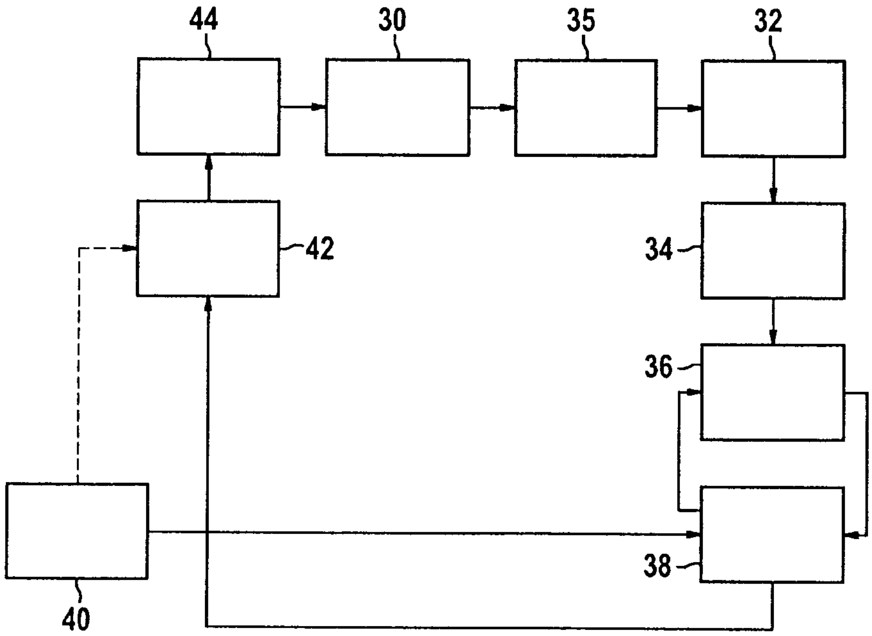

Fig. 2

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TECHNICAL FIELD

The present subject matter relates to a method for determining function parameters for a control unit and to a control unit.

BACKGROUND

In injection systems for internal combustion engines having electronic controllers, control units are used for execution according to requirements regarding outcomes or assessment criteria designed by the manufacturer and the end user with the function parameters.

The complexity of functions and therefore also the number of function parameters increase with increasing demands on the system. At the same time, the customer asks for a simplification of the structures as a complex software structure can be handled only with an expert knowledge and application of the complex software structure is difficult.

The above-mentioned control unit functions offer the possibility of using a set of parameters to determine by means of several sets of parameters, using constants, characteristic curves and maps fixed settings. It should be noted that the complexity of the functions and thus also the number of the maps are constantly increasing. Function specialists, who at best know the influence of each parameter, can be designed so that functions are performed according to customer requirements. The customer gets a desired compromise between a variety of optimal and possible compromises and deviations from the requirements can be met by only by recursion.

SUMMARY

This summary is provided to introduce concepts related to a method for determining function parameters for a control unit, and the concepts are further described below in the detailed description. This summary is neither intended to identify essential features of the claimed subject matter nor is it intended for use in determining or limiting the scope of the claimed subject matter.

In one embodiment, the subject matter describes a method for determining function parameters for a control unit, which is provided for actuating a technical system. In the

method, at least one target variable is predefined for a system behavior and a variation of the function parameters is carried out. From a received response to the function parameters, a evaluation of the set function parameters is carried out taking into account the at least one predefined target variable.

Brief Description Of The Figures

The present subject matter is explained in more details with the help of the following exemplary embodiments represented in the figures, without limiting the scope of the present subject matter, wherein:

Fig. 1 shows a schematic illustration of an embodiment of a method for determining function parameters for a control unit, according to the present subject matter.

Fig. 2 shows another embodiment of the method for determining function parameters for the control unit, according to the present subject matter.

Detailed Description

The present subject matter describes a method for determining function parameters having the features of claim 1 and a control unit with the features of claim 10, are presented. Further embodiments result from the dependent claims and the description hereinafter.

Through the use of self-replicating functions, a plurality of function parameters, characteristic curves and maps can be reduced for a user to one or a few operating point dependent weighting characteristic maps. Thus, even the complexity for the customer or the user can be reduced with increasing complexity of electronic controllers. The application is specified as the targets, criteria and their weightings. Thus, the user does not have to be a function specialist in order to implement the desired requirements of a system. It is further not necessary that the user knows the function parameters.

With the method, an application is made possible by direct specification of target criteria or target values for a function in the control unit. It is to be noted that by ever increasingly complex software structures, the professional requirements and the effort increases with the application both internally and at customer sides. The use of weighting functions with self-replicating functions maps allows the electronic controllers to change the system behavior directly over the outcomes or assessment criteria or by their weights and predictions. For users, thereby, a variety of function parameters, characteristic curves and mark-fields, are reduced to a few operating points depending on weighting characteristic maps.

The present subject matter allows an application over a set of targets, under which the concentration of the target variables and not the function parameters is possible. This leads to a reduction in complexity for the user, especially since no specialized function for calculation is necessary. With the present method, a systematic approach with a target assessment of attitudes is possible. Furthermore, recursions for adaptation of the requirements are less expensive. If necessary, a reduction of characteristics maps structures can be achieved in the control unit.

With this method, it is possible to develop a control unit function or to expand existing control unit functions, so that they apply this method to themselves. The function objectives are specified by a calibrator or a customer in a configuration through one or more weighting characteristics maps of the target parameters or criteria. The function gets the necessary internal function parameters.

Further advantages and embodiments of the present subject matter will become apparent from the description and the accompanying drawings. It is understood that the above-mentioned features and the features to be explained below can be used not only in the respectively specified combination, but can also be used in other combinations or alone without going beyond the scope of the present subject matter.

The present subject matter is illustrated schematically with reference to embodiments represented in figures and will be described hereinafter in detail with reference to the figures.

In Fig. 1, a sequence of method is outlined, in which a direct variation of parameters, such as function parameters, is applied on a technical system 10 and with that the system 10 is operated in different operating points. System response criteria can be calculated from the system 10 in a step 12. From the calculated criteria and predefined targets, a mathematical model or a criteria model, for example, a model 14, is then formed, which creates the dependencies of the targets and criteria on the parameters.

An optimizer 16 can optimize the model 14 based on a predetermined weighting criteria of a weighting characteristic map 18 and determines optimal function parameters 20, and actual functions of a control unit 22 are made available and again updated. The optimizer 16 is a development of system responses or may take into account the calculated system response criteria, for example, by a gradient consideration or evaluation.

The system 10 is actuated with an initial starting function parameter 20 of the control unit 22. The system 10 is operated at any one operating point having set function parameters 20, wherein the system 10 supplies output variables, on basis of which criteria is calculated. With such criteria, the mathematical model 14 is formed. The optimizer 16 determines the optimal parameters with predetermined weighting in a measured range of the mathematical model 14 and adjusts results based on the corresponding function parameters 20.

This means that the system 10 uses the start function parameters that were determined or, for example, provided. However, these parameters are generally not matched to the system 10, i.e., they are not optimal for the system 10.

At the beginning, the mathematical model 14 is typically not available for the determination of the function parameters 20. However, the mathematical model 14 of a similar system 10 can be provided.

The system 10 is then operated at different operating points and learns its own behavior at different operating points. In this process, the optimizer 16 outputs, prior to the function parameter combinations, a prediction of the optimizer 16 representing the improvement regarding the mathematical model 14. It is therefore tried/tested function parameter combinations that improve the behavior of the system 10. Then, the mathematical model 14 is updated to include the criteria and the combinations of the function parameters 20. With extended function parameters combinations and the related criteria, a new enhanced mathematical model 14 is formed.

The optimizer 16 uses the mathematical model 14 and checks whether the default function parameters 20 for the improvement or deterioration of the behavior of the system 10 has resulted. Thus, the optimizer 16 determines gradually the combination of the function parameters 20, for which the optimal behavior of the system 10 with respect to the set criteria results. This is done in an iterative process in which the mathematical model 14 is modified until an optimal behavior was found. This iterative process is performed at each operating point.

The optimizer 16 determines the optimal parameters in each of the mathematical model 14 in the tested range and outputs the prediction as to whether a further improvement in performance can be achieved or not. Thus, the task of the optimizer 16 is to evaluate the criteria of the mathematical model 14 according to the specification of the weighting characteristic map 18.

A default at the optimizer 16 is a sum of criterion weights, for which the optimizer 16 finds only one parameter as solution. Alternatively, the function is designed so that the optimizer 16 supplies a variety of function parameters 20 via a multi-target optimization and a selection of function parameters is made by the weighting of the criteria from the memory or model of optimal parameters. In this case, the weighting criteria can be moved any time after learning of the mathematical model 14. The function parameters 20 become immediately effective. In this way, a user can apply the method, without having the need to know the function parameters 20.

This results in two phases:

1. Fast learning of the function parameters 20 and the application of using the weighting characteristics maps 18.
2. Slowly adjust the function parameters 20 over the lifetime.

A phase change-over can be made by the information of the previous learned operational behavior. If the second phase is present after the multi-target optimization from a storage or the model of optimal parameters for the request of the function, the weights are changed at any time, for example, by switching different weighting characteristics maps 18 or by a rule applied directly on the weights.

Fig. 2 shows another embodiment of method similar to the method shown in Fig. 1, with the difference that function parameters 20 are not directly varied on a system 30, but via an intermediate model 32 in order to avoid significant impacts of the variations.

The intermediate model 32 replaces the system 30 and is aligned with the system 30 under defined conditions through identification, optimization, or by other calculations (as shown by block 35).

From the response of the intermediate model 32, criteria from the intermediate model 32 can be calculated in a step 34. From the calculated criteria and targets, for example, then a mathematical model or a criteria model 36 is formed, which creates the dependencies of the targets and criteria on the parameters.

An optimizer 38 can optimize the model 36 by specifying the weighting criteria from a weighting characteristic map 40 and can determine optimum operating parameters 42. In this way, these optimum operating parameters 42 and actual control unit 44 functions are available and constantly updated. The optimization can also be expected in a startup phase of the control unit 44.

Alternatively, the said calculation may be performed outside control unit software, and a tool with an interface transmitting the settings/variations to the control unit 44 of a test vehicle. Thus, results of the calculation are then made available directly in the control unit 44 or may be transferred via the tool to the control unit 44.

A particular advantage is that the control unit software can not be changed or configured. It should be noted that different setup arrangements or negotiations on the weights can not be implemented. Furthermore, an additional tool may also be available for the different applications and customers.