

Dynamic optimal control of thermal energy systems

Citation for published version (APA):

Delft, van, A. G. E. P. (1987). Dynamic optimal control of thermal energy systems. In *Systems and control : 1987 Benelux meeting, Houthalen, Belgium, January 21-23, 1987* (pp. 174). Katholieke Universiteit Leuven.

Document status and date:

Published: 01/01/1987

Document Version:

Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

www.tue.nl/taverne

Take down policy

If you believe that this document breaches copyright please contact us at:

openaccess@tue.nl

providing details and we will investigate your claim.

DYNAMIC OPTIMAL CONTROL OF THERMAL ENERGY SYSTEMS

A.G.E.P. van Delft

Dept. of Physics, T.U. Eindhoven (NL)

ABSTRACT

This paper describes a method of finding the dynamic optimal control strategy for thermal energy systems for residential heating. The system under study consists of a heat pump, combined with solar collectors and ground storage. Control variables are: the fluid flows between the components and the rotation speed of the heat pump compressor. The performance of the system is expressed in total energy consumption of heat pump and auxiliary heater over a fixed period. In this paper we will discuss some characteristics of the system, and their influence on the choice of the optimisation method. To calculate the optimal control, the iterative form of dynamic programming is used, with a modified conjugate gradient method.

Thus far, dynamic optimisation has been applied to three configurations. Reductions in energy consumption of about 20% are achieved (as compared to conventional control strategies) owing to a better exploitation of the components in the system, as well as a better anticipating on daily or seasonal changes in heat demand patterns. An example of this will be dealt with in the paper.

It can be concluded that dynamic optimal control establishes a significantly better system performance. Furthermore, this approach leads to a better system design, on the one hand because bottle-necks are revealed and system dimensions can be optimised in the same procedure, on the other hand because the results suggest more cost-effective layouts and configurations.

REFERENCES

- Bottram, A.M.M.; P.J.F. Slenders, "The control of thermal solar energy systems for space heating of houses and heating of tapwater", Journal A, 25(1984)4, pp 215-222.
- Delft, A.G.E.P. van; J.J. Meerman, "Dynamic optimisation of thermal energy systems: Methodology", ServoBode (Journal of the System and Control Engineering Group) 34 (1987), to be published.
- Meerman, J.J., "Dynamic optimisation of a heat pump system with solar collectors and seasonal storage", M.Sc.Thesis, Eindhoven University of Technology, 1986 (in Dutch).
- Rijk, C.A.E., "Dynamic optimal control of a solar energy system with seasonal storage", M.Sc.Thesis, Eindhoven University of Technology, 1985 (in Dutch).