INSTITUTE OF SIGNAL PROCESSING AND SYSTEM THEORY (ISS)

UNIVERSITÄT STUTTGART

Master Thesis (6M)

In collaboration with Institute for Building Energetics, Thermotechnology and Energy Storage (IGTE), University of Stuttgart and Solar and Heat Technology Stuttgart (SWT)

Thesis title	Development of an artificial neural network based procedure for the energy balancing of solar thermal systems
Thesis description	Currently, the energy balancing of thermal systems, e.g. solar thermal systems, is based on the measurement of the temperatures in the hot and in the cold side, as well as the volume flow rate of the heat transfer fluid in the circuit under consideration. With these data e.g. the heat input of a solar circuit into a hot water store can be determined by integrating the thermal power over time. The heat meters required for this (see Fig. 1) lead often to considerable costs, which represent a significant share of the total investment, especially for small solar thermal systems. For this reason, the energy balancing of such small systems is often omitted, which makes a reliable surveillance of the system performance impossible. This could be remedied by a method currently under development, in which the energy balancing of the entire system is to be carried out using only low-cost temperature sensors. This would make the determination of heat quantities much more cost-effective. In order to be able to carry out a complete energy balancing of thermal systems based on their hot water stores, the thermal energy supplied to and removed from the hot water store by the connected hydraulic circuits must be summed up. The change in the internal energy of the hot water store must also be taken into account. The overall goal of this thesis is the development of a method based on artificial neural networks (ANN) for determining the energy balance of the entire thermal system. Primarily, the temperatures recorded at different heights inside the hot water store are to be used as input variables. If necessary, the inlet and outlet temperatures of the connected hydraulic circuits can also be used (see Fig. 2). Additional input variables are the store volume and the heights of the temperature sensors and the hydraulic circuits that are attached to the hot water store. The development of this method is the content of this master thesis. As part of the process development, thermal systems will have to be balanced in terms of energy. Initially, measured values generated synthetically with the help of the program TRNSYS are used. Subsequently, measured values from real field test systems are used.
Qualifications	• Strong interest in this multi-disciplinary topic • Strong knowledge in deep learning and artificial neural networks • Proven programming skills in Python and Tensorflow
Begin	According to agreement
Duration	6M

Language	English or German
Supervisor	ISS + IGTE

Please contact Prof. Bin Yang (bin.yang@iss.uni-stuttgart.de) by email together with your Master transcript.

07.2022

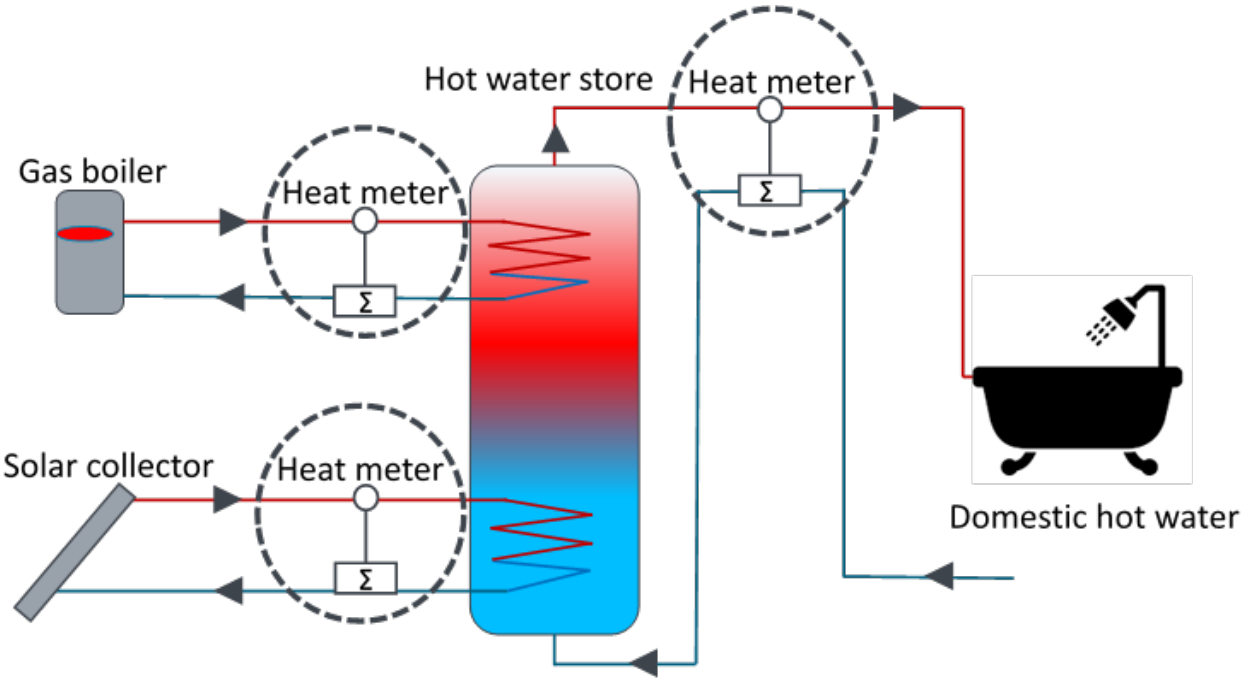

Fig. 1: Thermal system with conventional heat meters

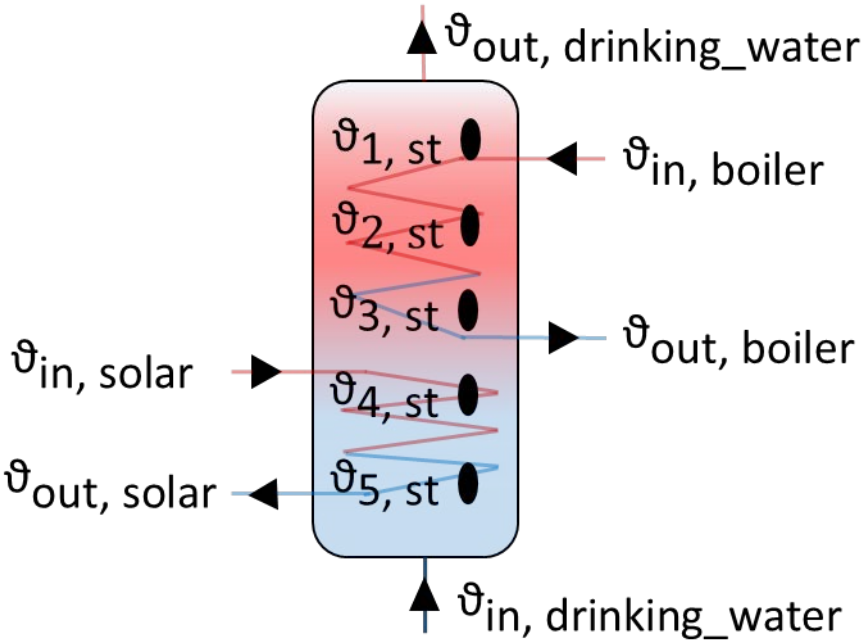

Fig. 2: Hot water store with temperature sensors