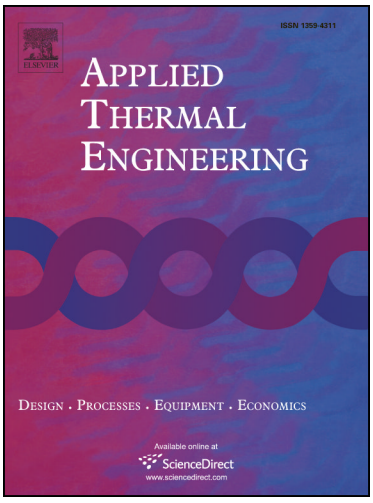

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DEVELOPMENT OF FREE-COOLING DETECTION PROCEDURES TO SUPPORT ENERGY INTELLIGENCE ACTIONS WITHIN TELECOMMUNICATION ENVIRONMENTS

Marco Sorrentino[1], Valentina Cirillo[1], Davide Panagrosso, Alena Trifirò[2], Filippo Bedogni[2]*

[1] Department of Industrial Engineering – University of Salerno, 84018 Fisciano (SA) - Italy
[2] Telecom Italia, Energy Group Plans&Certifications, Italy
* Corresponding author. Email: msorrentino@unisa.it; Tel. +39 089 96 4100; Fax +39 089 96 4037

Abstract
A signal-based diagnostic technique is proposed to enable remote monitoring of free-cooling (FC) systems operation in telecommunication (TLC) environments. The presented activity falls within a comprehensive energy intelligence action, which TIM-Telecom Italia has been carrying-on since more than a decade in its most strategic central offices and data centers. Main aim is to suitably exploit the available information, about temperature and electrical consumptions, so as to reduce its carbon footprint through strategic energy saving actions. The signal based procedure allows identifying in real-time what is the current status (i.e. properly working, not working or inefficient operation) of FCs in telecommunication rooms. Two alternative methodologies are proposed: one based on the analysis of temperature signal, through Discrete Fourier Transform (DFT), and the other on the evaluation of negative temperature time slope. This paper mostly focuses on the second methodology, which turned out to be the most effective one from a real-world deployability point of view. The results and experimental validation confirm the reliability and suitability of the proposed technique as an effective energy monitoring and diagnostic tool for TLC applications, to be deployed for leaner predictive maintenance tasks aimed at reducing FC failure dependent extra-costs. Further benefits include the synergies with control and/or supervisory energy management levels, which are expected to enable immediate counter-actions and upgrade current control logic, as well as the opportunity of supporting the execution of big-data energy intelligence actions within TLC central offices.

Keywords: Free-cooler detection; diagnostics; Energy Intelligence; Monitoring; Telecommunication; Thermal management

Nomenclature

AHU	Air handling unit
AC	Alternating current
ACCLC	Alternating current for climate control
ACTLC	Alternating current for telecommunication
C	Central office
DC	Direct current
EI	Energy intelligence
EML	Energy Management Logic
ES	Energy Station
FD	False detection
FC	Free-cooler
GD	Good detection
h	Specific enthalpy, [J/kg]
ICT	Information and communications technology
MD	Misdetection
N	Number of samples
R	Room
RMSE	root mean squared error
S	Slope
simul	Simulated
T	Temperature, [°C]
t	Time, [s]
Text	External temperature, [°C]
THL	Temperature, humidity, light
Thres	Threshold
TLC	Telecommunication
T_{room}	Room temperature, [°C]
WSN	Wireless sensor network
x	Specific humidity, [g/kg]
Δ	Variation