DEVELOPMENTS IN COST-EFFECTIVE SOLAR TRACKING

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ABSTRACT

Concerns over the environmental impact of fossil fuels in recent years have engendered a search for alternative, environmentally-friendly, renewable, energy sources. Amongst the several possible sources of renewable energy systems that have been exploited in recent years, wind and solar energy systems offer the most significant possibility for large-scale integration. The high initial cost of acquisition of wind /solar energy systems require further cost-mitigation strategies to support both the affordability, and the economics of exploiting these two renewable energy sources. Few locations on earth are equally endowed with these two renewable energy sources in exact proportions: hence the decision to exploit either one of them depends naturally on the incidence of natural occurrence of the source. The atmosphere which gave rise to the research development that resulted in the current work, was born in a geographical environment that has an abundance of solar energy. The research activities themselves were driven both by the need to make solar tracking systems cost-efficient, as a means of reducing the overall cost of acquiring solar energy systems; and by the need to develop systems that would operate robustly and reliably under challenging environmental conditions, over their quoted lifespan. Polar-axis solar tracking was identified for cost reduction: the discourse here shall, therefore, mainly highlight contributions in respect of polar-axis solar tracking, even though, most of the technical issues addressed in polar-axis solar tracking also apply to solar tracking systems in general. Specifically, the discourse begins with a general review and comparison of the relative issues around static and tracking solar systems. A review of the various types of tracking systems and their motive or drive systems, in terms of system modeling, dynamic performance and the economics issues, is presented. Solar tracking systems require information on the moment-by-moment position of the sun relative to a given platform (location), to effect tracking accuracy. Methodologies and the merits and demerits of sensor-based and sensorless identification of the position of the sun shall be discussed. Linear and non-linear model-based polar-axis tracking techniques shall be demonstrated. A discussion of frictional effects, ageing and parameter variation due to the weathering and natural elements shall be drawn-upon, to motivate the need for non-model based control of polar-axis solar tracking systems. Non-model-based control shall then be discussed. Artificial intelligence-based controllers

shall then be advanced. Constraint-based polar-axis solar tracking shall be discussed. Limitations of tracker economic as a means of lowering the cost of solar energy hardware shall be elucidated, to motivate the need for the hybrid exploitation of renewable energy systems. Conclusions and further research directions shall be discussed.

REFERENCES

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