

# Comparing Time-Series Clustering Algorithms in R Using the dtwclust Package

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## Abstract

Most clustering strategies have not changed considerably since their initial definition. The common improvements are either related to the distance measure used to assess dissimilarity, or the function used to calculate prototypes. Time-series clustering is no exception, with the Dynamic Time Warping distance being particularly popular in that context. This distance is computationally expensive, so many related optimizations have been developed over the years. Since no single clustering algorithm can be said to perform best on all datasets, different strategies must be tested and compared, so a common infrastructure can be advantageous. In this manuscript, a general overview of shape-based time-series clustering is given, including many specifics related to Dynamic Time Warping and other recently proposed techniques. At the same time, a description of the `dtwclust` package for the R statistical software is provided, showcasing how it can be used to evaluate many different time-series clustering procedures.

*Keywords:* time-series, clustering, R, dynamic time warping, lower bound, cluster validity.

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## 1. Introduction

Cluster analysis is a task which concerns itself with the creation of groups of objects, where each group is called a cluster. Ideally, all members of the same cluster are similar to each other, but are as dissimilar as possible from objects in a different cluster. There is no single definition of a cluster, and the characteristics of the objects to be clustered vary. Thus, there are several algorithms to perform clustering. Each one defines specific ways of defining what a cluster is, how to measure similarities, how to find groups efficiently, etc. Additionally, each application might have different goals, so a certain clustering algorithm may be preferred depending on the type of clusters sought (Kaufman and Rousseeuw 1990).

Clustering algorithms can be organized differently depending on how they handle the data and how the groups are created. When it comes to static data, i.e., if the values do not change with time, clustering methods can be divided into five major categories: partitioning (or partitional), hierarchical, density-based, grid-based and model-based methods (Liao 2005; Rani and Sikka 2012). They may be used as the main algorithm, as an intermediate step, or as a preprocessing step (Aghabozorgi *et al.* 2015).

Time-series is a common type of dynamic data that naturally arises in many different scenarios, such as stock data, medical data, and machine monitoring, just to name a few (Aghabo-

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# Comparing Time Series Clustering Algorithms In R Using The

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*Advanced Data Mining and Applications* Guojun Gan, Bohan Li, Xue Li, Shuliang Wang, 2018-12-28 This book constitutes the refereed proceedings of the 14th International Conference on Advanced Data Mining and Applications ADMA 2018 held in Nanjing China in November 2018 The 23 full and 22 short papers presented in this volume were carefully reviewed and selected from 104 submissions The papers were organized in topical sections named Data Mining Foundations Big Data Text and Multimedia Mining Miscellaneous Topics

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Sensing Technology Nagender Kumar Suryadevara, Bobby George, Krishanthi P. Jayasundera, Subhas Chandra Mukhopadhyay, 2023-04-08 This book gathers the latest advances innovations and applications in the field of sensing technology as presented by international researchers and engineers at the 15th International Conference on Sensing Technology ICST held in Sydney Australia on December 5 7 2022 Contributions include a wide range of topics such as vision sensing sensor signal processing sensors phenomena and modelling sensor characterization smart sensors and sensor fusion electromagnetic chemical and physical sensors electronic nose technology biosensors nano sensors wireless sensors and WSN Internet of Things optical sensors sensor arrays intelligent sensing Internet based and remote data acquisition The contributions which were selected by means of a rigorous international peer review process present a wealth of exciting ideas that will open novel research directions and foster multidisciplinary collaboration among different specialists

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**Digital Human Modeling and Applications in Health, Safety, Ergonomics and Risk Management. Human Body, Motion and Behavior** Vincent G. Duffy, 2021-07-03 This two volume set LNCS 12777 and 12778 constitutes the thoroughly refereed proceedings of the 12th International Conference on Digital Human Modeling and Applications in Health Safety Ergonomics and Risk Management DHM 2021 which was held virtually as part of the 23rd HCI International Conference HCII 2021 in July 2021 The total of 1276 papers and 241 posters included in the 39 HCII 2021 proceedings volumes was carefully reviewed and selected from 5222 submissions DHM 2021 includes a total of 56 papers they were organized in topical sections named Part I Human Body Motion and Behavior Ergonomics human factors and occupational health human body and motion modeling and language communication and behavior modeling Part II AI Product and Service Rethinking healthcare artificial intelligence applications and ethical issues and digital human modeling in product and service design

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**Efficient Pattern Discovery in Massive Time Series Databases** Li Wei, 2006

**Data Warehousing and Mining** John Wang, 2008 This collection offers tools designs and outcomes of the utilization of data mining and warehousing technologies such as algorithms concept lattices multidimensional data and online analytical processing With more than 300 chapters contributed by over 575 experts from around the globe this authoritative collection

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