# The Toolkit For Multivariate Data Analysis Tmva 4

Rachel Sandford

**The Toolkit For Multivariate Data Analysis Tmva 4:**

Machine Learning under Resource Constraints - Discovery in Physics Katharina Morik,Wolfgang Rhode,2022-12-31 Machine Learning under Resource Constraints addresses novel machine learning algorithms that are challenged by high throughput data by high dimensions or by complex structures of the data in three volumes Resource constraints are given by the relation between the demands for processing the data and the capacity of the computing machinery The resources are runtime memory communication and energy Hence modern computer architectures play a significant role Novel machine learning algorithms are optimized with regard to minimal resource consumption Moreover learned predictions are executed on diverse architectures to save resources It provides a comprehensive overview of the novel approaches to machine learning research that consider resource constraints as well as the application of the described methods in various domains of science and engineering Volume 2 covers machine learning for knowledge discovery in particle and astroparticle physics Their instruments e g particle detectors or telescopes gather petabytes of data Here machine learning is necessary not only to process the vast amounts of data and to detect the relevant examples efficiently but also as part of the knowledge discovery process itself The physical knowledge is encoded in simulations that are used to train the machine learning models At the same time the interpretation of the learned models serves to expand the physical knowledge This results in a cycle of theory enhancement supported by machine learning *Supersymmetric Beasts and Where to Find Them* Marco Valente,2022-03-05 After an extensive overview of the Standard Model and of the theory and phenomenology of Supersymmetry this book describes the recent development of the ATLAS Particle Flow algorithm a hadronic reconstruction technique aiming at enhancing the sensitivity of the experiment to new physics through the combination of the information from different ATLAS sub detectors The first ever ATLAS strong SUSY search exploiting this technique is also described reporting the results and exclusion limits obtained using the complete proton proton collision dataset recorded by the ATLAS experiment during the second Run of the Large Hadron Collider LHC **Physics with Photons Using the ATLAS Run 2 Data** Stefano Manzoni,2019-08-02 The work presented in this book is based on the proton proton collision data from the Large Hadron Collider at a centre of mass energy of 13 TeV recorded by the ATLAS detector in 2015 and 2016 The research program of the ATLAS experiment includes the precise measurement of the parameters of the Standard Model and the search for signals of physics beyond the SM Both these approaches are pursued in this thesis which presents two different analyses the measurement of the Higgs boson mass in the di photon decay channel and the search for production of supersymmetric particles gluinos squarks or winos in a final state containing two photons and missing transverse momentum Finally ATLAS detector performance studies which are key ingredients for the two analyses outlined before are also carried out and described *Study of Double Charm B Decays with the LHCb Experiment at CERN and Track Reconstruction for the LHCb Upgrade* Renato Quagliani,2018-11-04 This book discusses the study of double charm B decays and the first

observation of B0 D0D0Kst0 decay using Run I data from the LHCb experiment It also describes in detail the upgrade for the Run III of the LHCb tracking system and the trigger and tracking strategy for the LHCb upgrade as well as the development and performance studies of a novel standalone tracking algorithm for the scintillating fibre tracker that will be used for the LHCb upgrade This algorithm alone allows the LHCb upgrade physics program to achieve incredibly high sensitivity to decays containing long lived particles as final states as well as to boost the physics capabilities for the reconstruction of low momentum particles **Higgs Boson Decays into a Pair of Bottom Quarks** Cecilia Tosciri,2021-10-22 The discovery in 2012 of the Higgs boson at the Large Hadron Collider LHC represents a milestone for the Standard Model SM of particle physics Most of the SM Higgs production and decay rates have been measured at the LHC with increased precision However despite its experimental success the SM is known to be only an effective manifestation of a more fundamental description of nature The scientific research at the LHC is strongly focused on extending the SM by searching directly or indirectly for indications of New Physics The extensive physics program requires increasingly advanced computational and algorithmic techniques In the last decades Machine Learning ML methods have made a prominent appearance in the field of particle physics and promise to address many challenges faced by the LHC This thesis presents the analysis that led to the observation of the SM Higgs boson decay into pairs of bottom quarks The analysis exploits the production of a Higgs boson associated with a vector boson whose signatures enable efficient triggering and powerful background reduction The main strategy to maximise the signal sensitivity is based on a multivariate approach The analysis is performed on a dataset corresponding to a luminosity of 79 8 fb collected by the ATLAS experiment during Run 2 at a centre of mass energy of 13 TeV An excess of events over the expected background is found with an observed expected significance of 4 9 4 3 standard deviation A combination with results from other Hbb searches provides an observed expected significance of 5 4 5 5 The corresponding ratio between the signal yield and the SM expectation is 1 01 0 12 stat 0 16 0 15 syst The observation analysis was further extended to provide a finer interpretation of the V H H bb signal measurement The cross sections for the VH production times the H bb branching ratio have been measured in exclusive regions of phase space These measurements are used to search for possible deviations from the SM with an effective field theory approach based on anomalous couplings of the Higgs boson The results of the cross section measurements as well as the constraining of the operators that affect the couplings of the Higgs boson to the vector boson and the bottom quarks have been documented and discussed in this thesis This thesis also describes a novel technique for the fast simulation of the forward calorimeter response based on similarity search methods Such techniques constitute a branch of ML and include clustering and indexing methods that enable quick and efficient searches for vectors similar to each other The new simulation approach provides optimal results in terms of detector resolution response and reduces the computational requirements of a standard particles simulation *Searching for Squarks* Samuel Jones,2020-08-27 This thesis focuses on searches for squarks with the ATLAS detector in compressed

scenarios where the scalar top is very close in mass to the lightest supersymmetric particle These models are theoretically appealing because the presence of a quasi degenerate scalar top enhances the self annihilation cross section of the lightest supersymmetric particle acting therefore as a regulator of the dark matter relic density Two main analyses are presented the first is a search for scalar tops decaying to charm quarks The identification of jets originating from the charm quark is very challenging due to its short lifetime The calibration of tools for charm tagging has paved the way to measuring the decay of the Higgs boson to pairs of charm quarks The second analysis presented is the development of a novel technique for reconstructing low momentum b hadrons This tool has enabled the ATLAS collaboration to explore topologies that were previously inaccessible    **Combinatorial Kalman Filter and High Level Trigger Reconstruction for the Belle II Experiment** Nils Braun,2019-08-06 Combinatorial Kalman filters are a standard tool today for pattern recognition and charged particle reconstruction in high energy physics In this thesis the implementation of the track finding software for the Belle II experiment and first studies on early Belle II data are presented The track finding algorithm exploits novel concepts such as multivariate track quality estimates to form charged trajectory hypotheses combining information from the Belle II central drift chamber with the inner vertex sub detectors The eventual track candidates show an improvement in resolution on the parameters describing their spatial and momentum properties by up to a factor of seven over the former legacy implementation The second part of the thesis documents a novel way to determine the collision event null time T0 and the implementation of optimisation steps in the online reconstruction code which proved crucial in overcoming the high level trigger limitations    **First Evidence for Atmospheric Neutrino-induced Cascades with the IceCube Detector** Michelangelo Vincent D'Agostino,2009    *Charming Decays of the Higgs, Z, and W Bosons* Spandan Mondal,2025-06-13 This book presents searches for the Higgs boson Z boson and W boson decaying into charm quark s performed with proton proton collision data at s 13TeV collected by the CMS experiment at the LHC CERN corresponding to an integrated luminosity of 138 fb 1 and recorded between 2016 and 2018 The searches are carried out using events in which the Higgs Z W boson is produced in association with a leptonically decaying Z or W boson This thesis also discusses a novel calibration algorithm for charm jet identification that enables maximal use of the available information related to charm jets The new method is used to correct the entire distribution expected as output when jet flavour identification algorithms are applied to jets of different flavours The calibrated results improve over traditional efficiency measurements and help enhance the sensitivities of the Higgs Z and W searches This book primarily reports on the so called resolved jet topology of the Higgs Z W boson searches where the boson candidates are reconstructed using two separate small radius AK4 jets Upon statistically combining the results of the resolved jet search with a complementary merged jet approach the observed expected upper limit on the Higgs decay to charm quarks corresponds to 14 7 6 times the Standard Model expectation at the 95% CL which is the most stringent direct limit to date A significance of 5 7 5 9 over the background only prediction is observed expected in

case of the search for charmed Z boson decays Only the resolved jet topology is used in the search for charmed W decays and the observed expected significance is 5 6 5 7 over the background only prediction These mark the first observations of charmed decays of the Z and W bosons at a hadron collider experiment       Acta Physica Polonica ,2007       **Expected Performance of the ATLAS Experiment** ,2009       Multivariate Data Analysis Kim Esbensen,2002       Making Sense of Multivariate Data Analysis John Spicer,2005 A short introduction to the subject this text is aimed at students practitioners in the behavioural social sciences It offers a conceptual overview of the foundations of MDA of a range of specific techniques including multiple regression logistic regression log linear analysis       Multivariate Data Analysis with Readings Joseph F. Hair,1995 Examining your data Multiple regression analysis Multiple discriminat analysis Multivariate analysis of variance Canonical correlation analysis Factor analysis Cluster analysis Multidimensional scaling Conjoint analysis Structural equation modeling       **Multivariate Data Analysis** Joseph F. Hair,William C. Black,Barry J. Babin,Rolph E. Anderson,2019       Analyzing Multivariate Data Paul E. Green,J. Douglas Carroll,1978 Single criterion multiple predictor association Multiple criterion multiple predictor association The analysis of interdependence       **Multivariate Statistical Methods** Bryan F. J. Manly,Jorge A. Navarro Alberto,Ken Gerow,2024-10-04 Multivariate Statistical Methods A Primer offers an introduction to multivariate statistical methods in a rigorous yet intuitive way without an excess of mathematical details In this fifth edition all chapters have been revised and updated with clearer and more direct language than in previous editions and with more up to date examples exercises and references in areas as diverse as biology environmental sciences economics social medicine and politics Features A concise and accessible conceptual approach that requires minimal mathematical background Suitable for a wide range of applied statisticians and professionals from the natural and social sciences Presents all the key topics for a multivariate statistics course The R code in the appendices has been updated and there is a new appendix introducing programming basics for R The data from examples and exercises are available on a companion website This book continues to be a great starting point for readers looking to become proficient in multivariate statistical methods but who might not be deeply versed in the language of mathematics In this edition we provide readers with conceptual introductions to methods practical suggestions new references and a more extensive collection of R functions and code that will help them to deepen their toolkit of multivariate statistical methods       *Applied Multivariate Statistical Analysis* Wolfgang Karl Härdle,Léopold Simar,2015-02-26 Focusing on high dimensional applications this 4th edition presents the tools and concepts used in multivariate data analysis in a style that is also accessible for non mathematicians and practitioners All chapters include practical exercises that highlight applications in different multivariate data analysis fields All of the examples involve high to ultra high dimensions and represent a number of major fields in big data analysis The fourth edition of this book on Applied Multivariate Statistical Analysis offers the following new features A new chapter on Variable Selection Lasso SCAD and Elastic Net All exercises are supplemented by R and MATLAB code that can be found on

www quantlet de The practical exercises include solutions that can be found in H rdle W and Hlavka Z Multivariate Statistics Exercises and Solutions Springer Verlag Heidelberg     **Essentials of Multivariate Data Analysis** Neil H. Spencer,2013-12-17 Since most datasets contain a number of variables multivariate methods are helpful in answering a variety of research questions Accessible to students and researchers without a substantial background in statistics or mathematics Essentials of Multivariate Data Analysis explains the usefulness of multivariate methods in applied research Unlike most books on multivariate methods this one makes straightforward analyses easy to perform for those who are unfamiliar with advanced mathematical formulae An easily understood dataset is used throughout to illustrate the techniques The accompanying add in for Microsoft Excel can be used to carry out the analyses in the text The dataset and Excel add in are available for download on the book s CRC Press web page Providing a firm foundation in the most commonly used multivariate techniques this text helps readers choose the appropriate method learn how to apply it and understand how to interpret the results It prepares them for more complex analyses using software such as Minitab R SAS SPSS and Stata     **Applied Multivariate Data Analysis** Brian Everitt,2001

Decoding **The Toolkit For Multivariate Data Analysis Tmva 4**: Revealing the Captivating Potential of Verbal Expression

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