

Using Global Navigation Satellite Systems for modeling Athletic Performances in elite football players

Frank Imbach^{1,2,3,*}, Waleed Ragheb^{1,4,+}, Valentin Leveau^{1,4,+}, Romain Chailan^{1,4}, Robin Candau³, and Stephane Perrey²

¹Seenovate, Montpellier, 34000, France

²EuroMov Digital Health in Motion, Univ Montpellier, IMT Mines Ales, Montpellier, 34090, France

³DMeM, Univ Montpellier, INRAe, Montpellier, 34000, France

⁴LIRMM, Univ Montpellier, CNRS, Montpellier, 34000, France

*frank.imbach@umontpellier.fr

+these authors contributed equally to this work

1 Appendix 1

Data set description

Table A1. Summary of explanatory variables computed by the manufacturer

Predictor variables	X_i	Description
TD	X_1	Total distance covered by a player (km)
D_{0-5}	X_2	Distance covered at a running speed below 5 km.h^{-1}
D_{5-10}	X_3	Distance covered at a running speed between 5 km.h^{-1} and 10 km.h^{-1}
D_{10-15}	X_4	Distance covered at a running speed between 10 km.h^{-1} and 15 km.h^{-1}
D_{15-21}	X_5	Distance covered at a running speed between 15 km.h^{-1} and 21 km.h^{-1}
D_{21-24}	X_6	Distance covered at a running speed between 21 km.h^{-1} and 24 km.h^{-1}
D_{24-30}	X_7	Distance covered at a running speed between 24 km.h^{-1} and 30 km.h^{-1}
D_{30}	X_8	Distance covered at a running speed over 30 km.h^{-1}
HID_{15}	X_9	Distance covered at high intensity (over 30 km.h^{-1})
HID_{21}	X_{10}	Distance covered at high intensity (over 21 km.h^{-1})
Acc_3	X_{11}	Number of accelerations performed over 3 m.s^{-2}
$Acc_{3.5}$	X_{12}	Number of accelerations performed over 3.5 m.s^{-2}
Acc_4	X_{13}	Number of accelerations performed over 4 m.s^{-2}
Dec_3	X_{14}	Number of decelerations performed over 3 m.s^{-2}
$Dec_{3.5}$	X_{15}	Number of decelerations performed over 3.5 m.s^{-2}
Dec_4	X_{16}	Number of decelerations performed over 4 m.s^{-2}
$Sprint_{24}$	X_{17}	Number of running sprints over 24 km.h^{-1}
$Speed_{avg}$	X_{18}	Averaged running speed of the session (km.h^{-1})
$Speed_{max}$	X_{19}	Maximal running speed reached during the session (km.h^{-1})
Acc_{max}	X_{20}	Maximal accelerations performed during the session (m.s^{-2})
Player	X_{22}	Player's id

Overview of the most selected features for predictive analysis tasks

Table A2. Top ten selected features for predictive tasks. A complete significance of feature extracted from raw data is provided by Christ et al.¹.

Feature	source
acc_3.5mss	commercial features
acc_3mss	commercial features
acc_4mss	commercial features
d_speed_0_5	commercial features
d_speed_10_15	commercial features
d_speed_15_21	commercial features
d_speed_5_10	commercial features
dec_3.5mss	commercial features
dec_3mss	commercial features
distance	commercial features
mean_second_derivative_central	raw data
partial_autocorrelation_lag_2	raw data
change_quantiles__f_agg_"var"__isabs_True__qh_0.8__ql_0.6	raw data
change_quantiles__f_agg_"mean"__isabs_False__qh_1.0__ql_0.6	raw data
change_quantiles__f_agg_"mean"__isabs_False__qh_1.0__ql_0.8	raw data
fft_coefficient__attr_"real"__coeff_75	raw data
fft_coefficient__attr_"imag"__coeff_90	raw data
friedrich_coefficients__coeff_2__m_3__r_30	raw data
friedrich_coefficients__coeff_3__m_3__r_30	raw data
matrix_profile__feature_"min"__threshold_0.98	raw data

References

1. Christ, M., Braun, N. & Neuffer, J. Overview on time series feature extraction (tsfresh—a python package).