

Opracowanie metody selekcji, integracji
i przetwarzania danych z systemów
sensorycznych do monitorowania pacjentów
stosujących ortezy stawu skokowego i stopy

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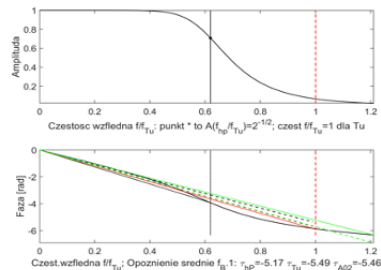
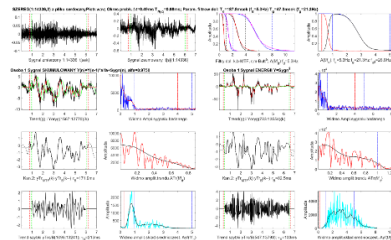
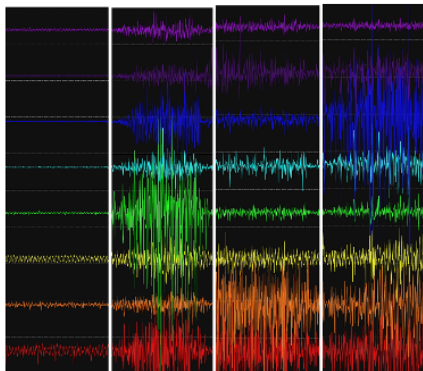


Edukacja

2014 — 2018	Technik Informatyk	Zespół Szkół Technicznych w Tarnowie
2018 — 2022	Studia inżynierskie	Akademia Tarnowska
2022 — 2023	Studia magisterskie	Akademia Górniczo-Hutnicza
2023 — 2025	Szkoła doktorska	Akademia Górniczo-Hutnicza



Praca inżynierska: Analiza sygnałów EMG w zastosowaniu protetycznym



Konferencyjny PPRAI 2023 (2 cytowania)



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Analysis of Surface EMG Signals to Control of a Bionic Hand Prototype



Pliki

21. Analysis_surface_EMG_Pieprzycki_KroL_2023.pdf
(1.07 MB)

Data

2023

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Wydawnictwo Politechniki Łódzkiej
Lodz University of Technology Press

Abstrakt

The aim of the presented project is to develop a comprehensive system for acquiring surface EMG data and carry out time-frequency analysis to determine useful parameters for subsequent gesture classification for a simple bionic hand prosthesis. This system is expected to assist in controlling both the prosthetic hand and the robotic hand in making precise gestures with the fingers on the hand. The article presents the methods for acquiring and processing multi-channel EMG signals and feature extraction for gesture recognition by an artificial neural network (ANN).

Słowa kluczowe

bionic hand, surface EMG, sEMG, neural network, NN, fast Fourier transform, FFT, Hilbert-Huang Transform, HHT, blind source separation, BSS, ręka bioniczna, powierzchnia EMG, sEMG, sieć neuronowa, NN, szybka transformata Fouriera, FFT, transformata Hilberta-Huanga, HHT, ślepa separacja źródeł, BSS

Cytowanie

Pieprzycki A., Król D., Wawryka P., Łachut K., Hamera M., Srebro B., Analysis of Surface EMG Signals to Control of a Bionic Hand Prototype. W: Progress in Polish Artificial Intelligence Research 4, Wojciechowski A. (Ed.), Lipiński P. (Ed.), Seria: Monografie Politechniki Łódzkiej Nr. 2437, Wydawnictwo Politechniki Łódzkiej, Łódź 2023, s. 145-150, ISBN 978-83-66741-92-8, doi: 10.34658/9788366741928.21.

URI

<http://hdl.handle.net/11652/4797>
<https://doi.org/10.34658/9788366741928.21>

Kolekcje

Rozdziały



Analiza sygnałów elektromiograficznych w zastosowaniu protetycznym

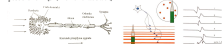
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Omówienie mechanizmów biologicznego sterowania pracą mięśni

Oddziaływanie na układ mięśniowy naczu ciwiotwka, odbywa się zgodnie z zasadą: feed-forward, feedback. Oddziaływanie feed-forward (przewidywanie), dotyczy pobudzenia dla określonego celu, z feedback odpowiadają na konsekwencje. Oddziaływanie to mają naturę elektryczną i polega na generowaniu tzw. sygnałów elektromiograficznych (skłóci EMG), przetwarzanych z odwołaniem lub kory mierzonych do właściwych wskazań mięśni odpowiednio połączonych aksonalnymi z prędkością ok. 70-120 m/s.

Znaczną część oddziaływań odbywa się poza świadomością człowieka (pobudzanie mięśni nerwa, układów itp.). Świadome decyzje określające cel pobudzenia mięśni, można narać woli

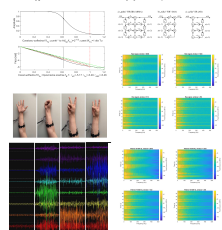


Ciałoświł traci możliwości hiperrefleksji (nawet, zwiększenia siły wtkiem) wskazuje po uszkodzeniu. Kieruje ciałoświłi naci się z prędkością wskazań mięśniowych, która jest statystycznie niezmienna, to wyrażenie jest warunkiem koniecznym pobudzenia ciałaświłi.

Utrzymany zapis audio na podstawie sygnałów mięśniowych tzw. "mocy mięśni", może podkazywać do wspomnianego subiektywności i w zastosowaniu protetycznym dla osób, które są po uszkodzeniu kończyn górnych.

Wykorzystane metody przetwarzania sygnałów

Ważne jest również ma podkazywać subiektywności jak Moving Target based Filter, dla stanu korzystniejszą charakterystykę amplitudową do czepności fAP i mniej korzystną dla wyższych czepności (wzrostu opadanie amplitudy) Rysunek 1-mowy prowadzenia szczegółowo właściwości tego filtru z uwzględnieniem nieliniowości charakterystyki słuchowej.



Wykorzystane techniki pomiarowe

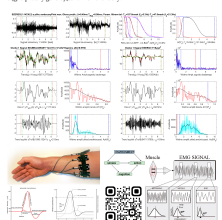
Przykładowy obraz sygnału, odpowiadający sytuacji palca środkowego i wskazującego itp. "Spider Man" pokazano na rysunku 2. Widac na nim efekt sterowania pracą, mięśni agnacy (przy rozdzielonej dłoni widoczny jest płatek).



Rysunek 2a 1-moważna na przykładzie rozmowy rozmowy, wyciągniętych kładek w stronę awaryjną, patrząc od strony pacjenta. Należy zwrócić uwagę na ukłonie elektrody względem sprzączki, co pokazano na rysunku 2.6 a). Porycja mięśnia (brachialis radialis) jest obserwowana przy naciśnięciu dłoni (ciężka).

Badania właściwości sygnałów diagnostycznych EMG

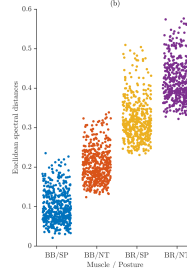
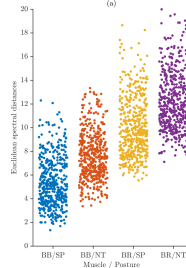
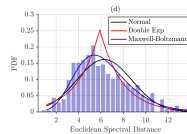
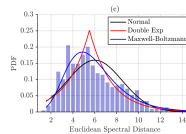
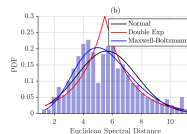
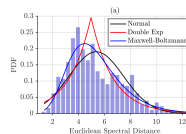
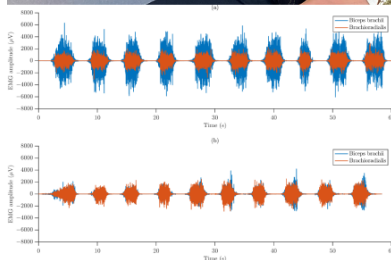
Celem badań było stwierdzenie na ile sygnał diagnostyczny odróżniałby wóły osoby wykonującej określone ruchy palcami i dłoni. Przypadek, w którym wóły był składowa wolnozmierzona rytmu, zmieniająca w zakresie pracy mięśni, która można znacznie odzwierciedlić sygnały elektryczne, w celu oddziaływania na ciałoświłi generującą narać ruchy.



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- [2] [3] [4] [5] [6] [7] [8] [9] [10] [11] [12] [13] [14] [15] [16] [17] [18] [19] [20] [21] [22] [23] [24] [25] [26] [27] [28] [29] [30] [31] [32] [33] [34] [35] [36] [37] [38] [39] [40] [41] [42] [43] [44] [45] [46] [47] [48] [49] [50] [51] [52] [53] [54] [55] [56] [57] [58] [59] [60] [61] [62] [63] [64] [65] [66] [67] [68] [69] [70] [71] [72] [73] [74] [75] [76] [77] [78] [79] [80] [81] [82] [83] [84] [85] [86] [87] [88] [89] [90] [91] [92] [93] [94] [95] [96] [97] [98] [99] [100] [101] [102] [103] [104] [105] [106] [107] [108] [109] [110] [111] [112] [113] [114] [115] [116] [117] [118] [119] [120] [121] [122] [123] [124] [125] [126] [127] [128] [129] [130] [131] [132] [133] [134] [135] [136] [137] [138] [139] [140] [141] [142] [143] [144] [145] [146] [147] [148] [149] [150] [151] [152] [153] [154] [155] [156] [157] [158] [159] [160] [161] [162] [163] [164] [165] [166] [167] [168] [169] [170] [171] [172] [173] [174] [175] [176] [177] [178] [179] [180] [181] [182] [183] [184] [185] 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Praca magisterska: Analiza porównawcza sygnałów EMG



Cel badania: opracowanie metody porównywania zmienności sygnałów EMG wewnątrz grupy (tj. pomiarów pojedynczego pacjenta) i międzygrupowo

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Intra- and Inter-Individual Spectral Pattern Variability of sEMG in Elbow Flexor Motor Tasks

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Sensors **2026**, *26*(3), 878; <https://doi.org/10.3390/s26030878>

Submission received: 16 December 2025 / Revised: 26 January 2026 / Accepted: 27 January 2026 /
Published: 29 January 2026





Novel approach in diagnosing of peripheral muscles diseases by EMG signal dynamic

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Introduction

The needle electromyography (nEMG) is the method of choice used to diagnose muscular disorders. nEMG is safe but painful and requires at times discontinuation of anticoagulant therapy.



Needle EMG

Invasive, painful, requires anticoagulant management



Surface EMG

Non-invasive, painless, no anticoagulant management

In this study, we investigated reliability of EMG recorded with surface electrodes (sEMG) with subsequent digital transformation in detecting myopathic and neurogenic changes.

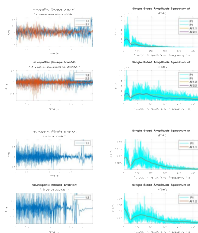
Methods

nEMG recording were assessed visually by investigator blinded to sEMG recording.

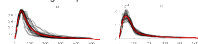


20 patients group are calculated, myopathic and neurogenic cases. Average age is 65 years old $\pm$ 12 years. sEMG signal was transformed using classification of averaged Fourier spectra (centroids) and the signal power distances and the Minkowski metric.

Results



The transformed sEMG signal was different in all groups. It confirms discriminative properties of smoothed spectra, that means the method may be useful in diagnosis practice.



Conclusion

These preliminary data showed differences of transformed sEMG in myopathic and neurogenic muscles and they warrant the future study on a bigger sample with analysis of sensitivity and specificity. Reliability of sEMG with investigated digital transformation may allow in the future to limit the painful and frequently troublesome nEMG.



Piotr Szczepan Wawryka

attended the
2025 PERIPHERAL NERVE SOCIETY ANNUAL
MEETING
17-20 May 2025
Edinburgh International Conference Centre (EICC)
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Charlotte Sumner, MD
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Współprace



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Laboratorium fizjoterapii



Szpital Uniwersytecki

lek. Jakub Antczak

Pomiary EMG



Akademia Tarnowska

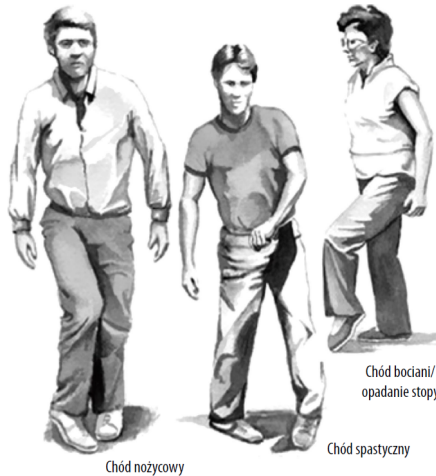
prof. Jan Duda



Wsparcie merytoryczne

Problem badawczy

- Rehabilitacja pacjentów z zaburzeniami narządu ruchu i schorzeniami neurologicznymi wymaga długotrwałego stosowania ortez stawu skokowego i stopy (AFO), w liczbach od 15 do 30 tys. nowych pacjentów rocznie.



Problem badawczy

- Do rehabilitacji stosuje się badania okresowe, brakuje ciągłej oceny postępów.



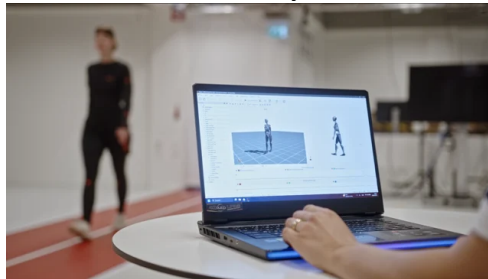
Problem badawczy

- Obecna ocena postępów rehabilitacji opiera się głównie na okresowych badaniach klinicznych i subiektywnej obserwacji fizjoterapeutów.



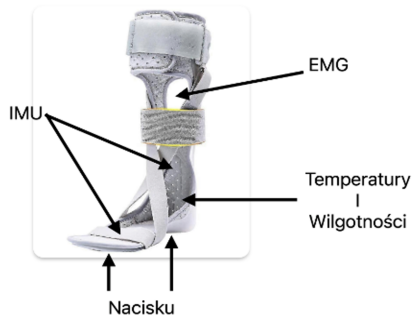
Problem badawczy

- Brakuje kompleksowych rozwiązań umożliwiających ciągłe monitorowanie użytkowania ortez w warunkach codziennych.



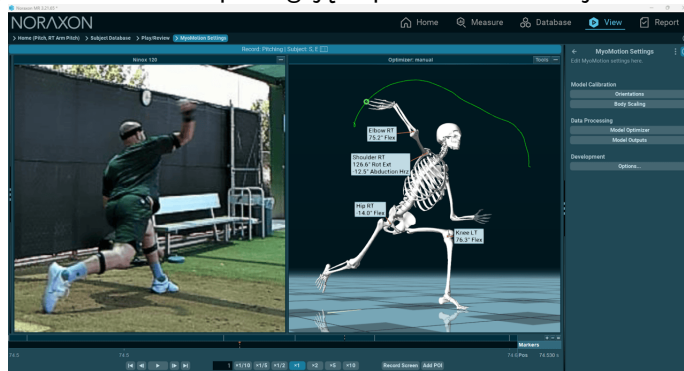
Problem badawczy

- Integracja różnych typów czujników (IMU, czujniki nacisku, EMG, czujniki środowiskowe) oraz interpretacja pozyskiwanych danych stanowią istotne wyzwanie techniczne.



Problem badawczy

- Konieczne jest opracowanie metod przekształcania danych pomiarowych w obiektywne wskaźniki wspomagające proces rehabilitacji.



Cel

Opracowanie kompleksowej metodologii doboru, integracji i implementacji systemów czujnikowych przeznaczonych do monitorowania pacjentów korzystających z ortezy stawu skokowego i stopy (AFO).

Plan działania:

- dobór i rozmieszczenie czujników oraz opracowanie sposobów ich integracji z ortezą,
- zaprojektowanie architektury sprzętowej i komunikacyjnej zapewniającej niezawodne pozyskiwanie danych,
- opracowanie narzędzi do przetwarzania sygnałów, fuzji danych i analizy chodu,
- wyznaczanie parametrów biomechanicznych i klasyfikacja aktywności pacjenta,
- automatyczne generowanie raportów i wizualizacji wspierających fizjoterapeutów i lekarzy,
- walidacja opracowanego systemu w badaniach eksperymentalnych z udziałem pacjentów.



Dziękuję za uwagę

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