Figure 3 – Main display model

Figure 4 – Single Model of Halberd

With the help of Unity3D and Maya, the exhibition hall has created a virtual space that combines education and entertainment. The realistic 3D scenes and rich interactive elements allow visitors to learn and explore immersively, while these weapons serve not only as witnesses of history but also as a bridge for the inheritance and development of military-industrial culture [1], injecting new vitality into the protection and exchange of historical and cultural heritage.

References

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RESEARCH ON EMG ARTIFACT SUPPRESSION METHOD FOR EEG SIGNALS BASED ON 1D-CNN-LSTM HYBRID MODEL

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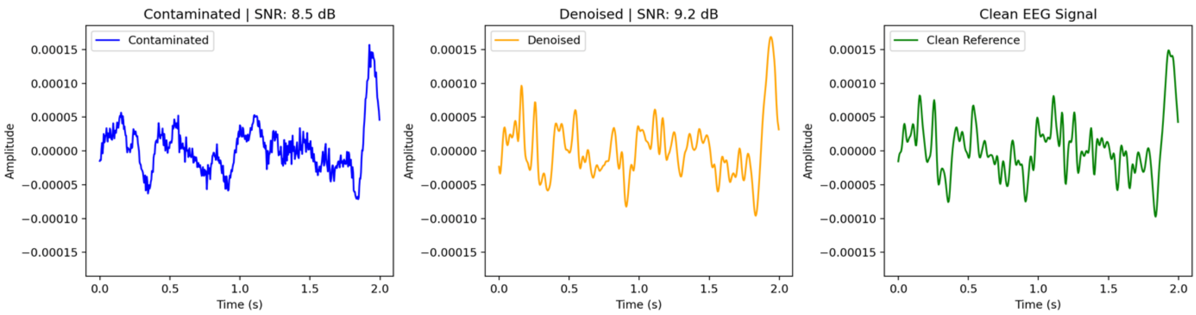
Summary. *Electroencephalography (EEG), as the core physiological signal reflecting the electrical activity of brain neurons, is susceptible to muscle activity interference during acquisition, generating Electromyography (EMG) artefacts that prove difficult to separate using conventional methods. Therefore, this paper proposes a hybrid 1D-CNN + LSTM framework incorporated with a mixed loss function. This approach enables precise suppression of EMG artefacts while retaining valid EEG components, realizing efficient and distortion-free purification of EEG signals.*

EEG is a vital physiological indicator of brain neuronal electrical activity, invaluable for clinical diagnosis and Brain-Computer Interface (BCI) development. Due to its weak amplitude (tens of microvolts), EEG is prone to EMG artefacts from muscle-related physiological activities during acquisition, which overlap with critical EEG bands and are hard to separate effectively via conventional thresholding or signal rejection methods, impairing data reliability. This paper proposes a hybrid 1D-CNN + LSTM model that precisely eliminates EMG artefacts while preserving valid EEG information, providing an efficient solution for real-time preprocessing of portable EEG devices.

This study used the "EEG Motor Movement/Imagery Dataset" (top 30 subjects, 1–2 min recordings) [1]. After resampling to 250 Hz and filtering (1–30Hz, 6th-order Butterworth), muscle artifacts were simulated by superimposing band-pass-filtered (30–100 Hz, 4th-order Butterworth) random Laplace noise onto clean signals. Then, signals were normalized within each time window and split into training-validation sets (9:1).

The model adopts a hybrid 1D-CNN + LSTM architecture: the input is EEG signals of shape (n_channels, 500). The CNN module includes two convolutional layers with decreasing kernels, padding (to retain signal length), and LeakyReLU activation. A 2-layer bidirectional LSTM (128 hidden units) captures temporal dependencies, while the decoder uses two fully connected layers to map features back to the original channel count, outputting a denoised signal of the same dimensions. Training utilized the Adam optimizer, a mixed loss function (70 % Huber loss + 30 % correlation loss) for amplitude and waveform optimization, 100 epochs, and a ReduceLROnPlateau scheduler for dynamic learning rate adjustment to enhance convergence.

To evaluate denoising performance, quantitative assessment used SNR (higher values indicating better performance), while qualitative analysis visualized time-domain waveforms and Power Spectral Density (PSD) plots to compare signal characteristics before and after denoising, highlighting artifact suppression and valid signal preservation.



a – contaminated EEG signals *b* – denoised signal *c* – clean reference signal

Figure 1 – Time-domain waveform comparison

Evaluation results demonstrate that the denoised signal exhibits a significant SNR improvement from 8.5 dB to 9.2 dB, while its time-domain waveform, as illustrated in figure 1, shows a clear trend of approaching the clean reference signal. In the frequency domain (figure 2), the denoised signal's power in the above 30 Hz EMG artefact band is notably suppressed, with its power spectral density overlapping substantially with that of the clean signal within the valid 1–30 Hz EEG band, effectively preserving the core brain electrical activity features.

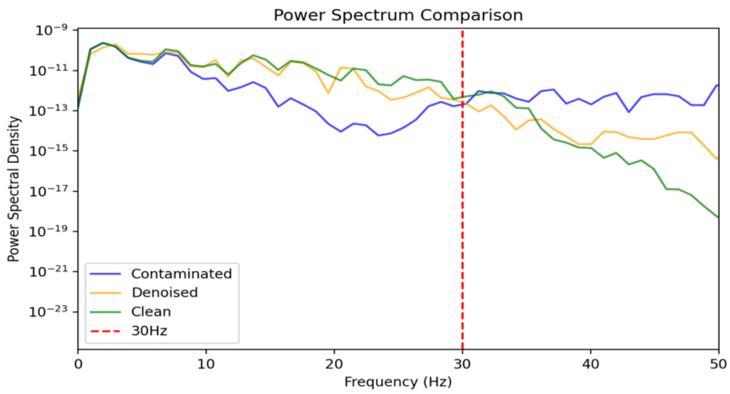


Figure 2 – Comparison of PSD among Contaminated, Denoised, and Clean EEG Signals

This experiment explored the use of a hybrid 1D-CNN + LSTM model for EMG artefact removal in EEG signals. Denoised signals showed notable SNR improvement and good alignment with clean signals in both time and frequency domains. With stable training and no overfitting, the model effectively suppressed artefacts above 30 Hz while well preserving valid 1–30 Hz EEG components. This approach holds promising potential for applications in clinical EEG diagnosis, BCI performance optimisation, and the development of portable EEG devices.

References

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REMOTE ACCESS SYSTEM FOR DIGITAL X-RAY DETECTOR PHOTONICS SCIENCE

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Summary. *The Photonics Science detector system includes a control computer operating under Windows XP, equipped with specialized software that provides management of X-ray imaging modes as well as capabilities for data acquisition, storage, and analysis. Functions for which Internet-based remote access must be provided include: X-ray image preview, pixel binning operations, exposure parameter adjustment, and the transfer of experimental data using cloud-based or local network storage technologies.*

The 2-D X-ray camera Photonic Science model X-RAY FDI-VHR 1:2. includes a detection unit, a power supply module, a water pump for detector cooling, a control computer equipped with a frame-grabber card, and software for image acquisition and processing. The detection unit incorporates a CCD sensor coupled