Supplementary Materials

Fatigue Life Predictor: Predicting Fatigue Life of Metallic Material Using LSTM with Contextual Attention Model

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Case Number	Strain (ε_{min} to ε_{max})	Treatment
1–1	0.18–0.36	Heat
1–2		Heat–HDPEC
2–1	0.198–0.396	Heat
2–2		Heat–HDPEC
3–1	0.216–0.432	Heat
3–2		Heat–HDPEC
4–1	0.234–0.468	Heat
4–2		Heat–HDPEC
5–1	0.252–0.504	Heat
5–2		Heat–HDPEC
6–1	0.27–0.54	Heat
6–2		Heat–HDPEC

Table S1. Case numbers, treatment types, and strain ranges (ε_{min} to ε_{max}) as depicted in Fig. 3.

p-values	**R^2**	**MAE**	**RMSE**
LSTM w/ attention vs LSTM	0.000109001	0.00032739	3.19E-05
LSTM w/ attention vs CNN w/ attention	0.032042062	0.047439122	0.00062274
CNN w/ attention vs CNN	0.937927232	0.236406649	0.999897435

Table S2. p-values for pairwise comparisons of different models (LSTM with attention, LSTM, CNN with attention, and CNN) based on performance metrics (R^2, MAE, and RMSE).

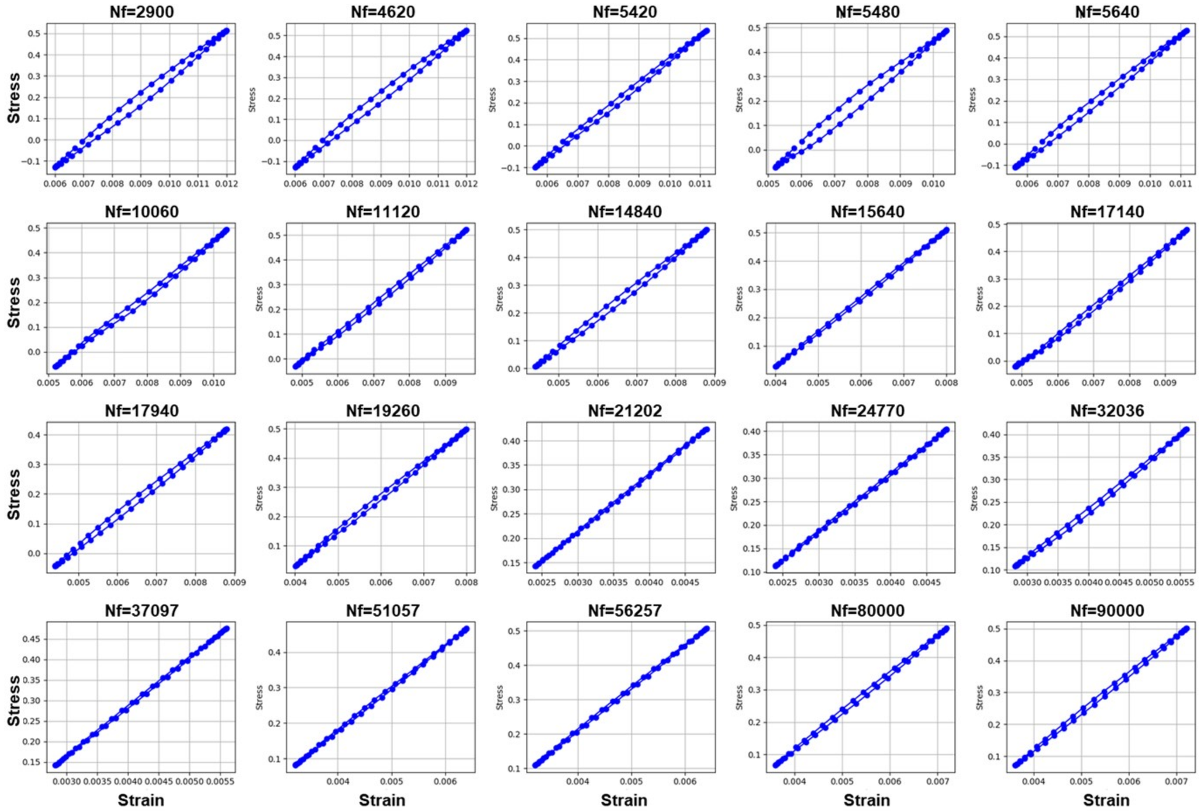

Figure S1. Stress-strain relationships at Cycle 20 for SUS316 stainless steel specimens under low-cycle fatigue conditions (Supplementary Dataset).

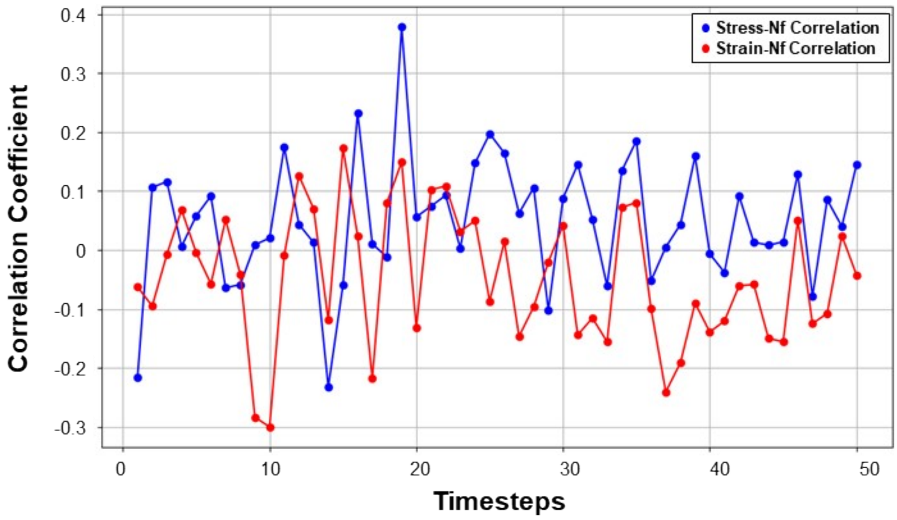

Figure S2. Temporal correlation analysis between stress (blue), strain (red), and fatigue life without data processing

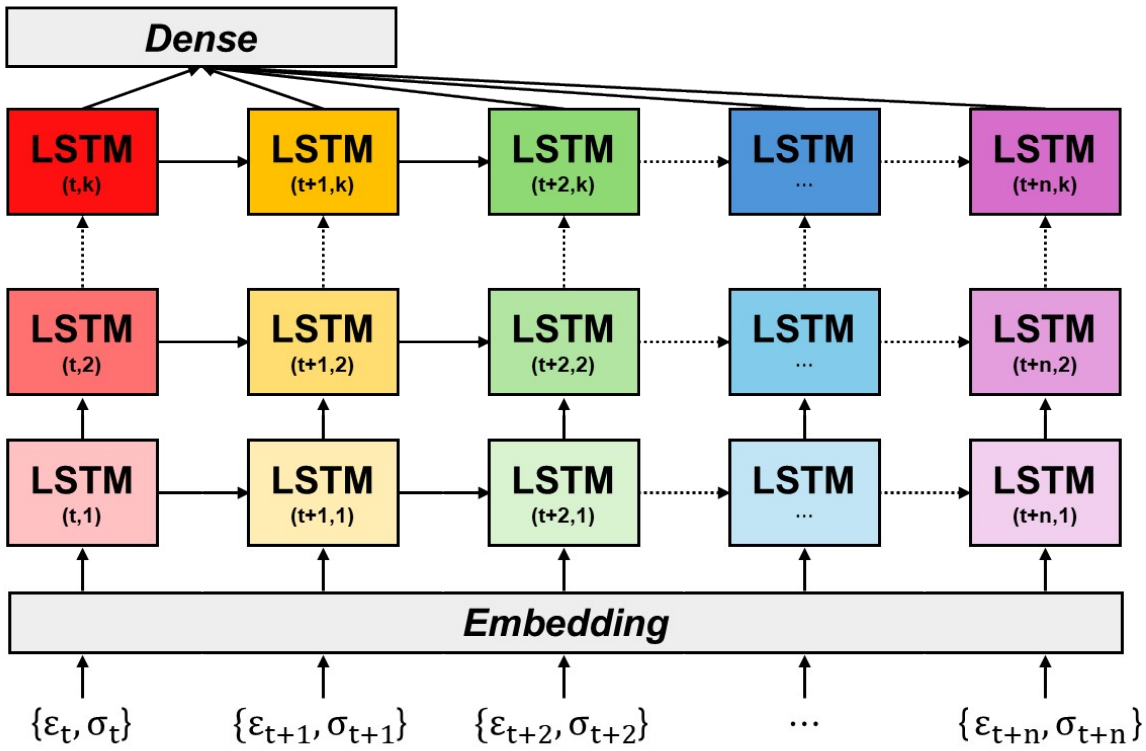

Figure S3. Architecture of the LSTM-based fatigue life prediction model without an attention mechanism.

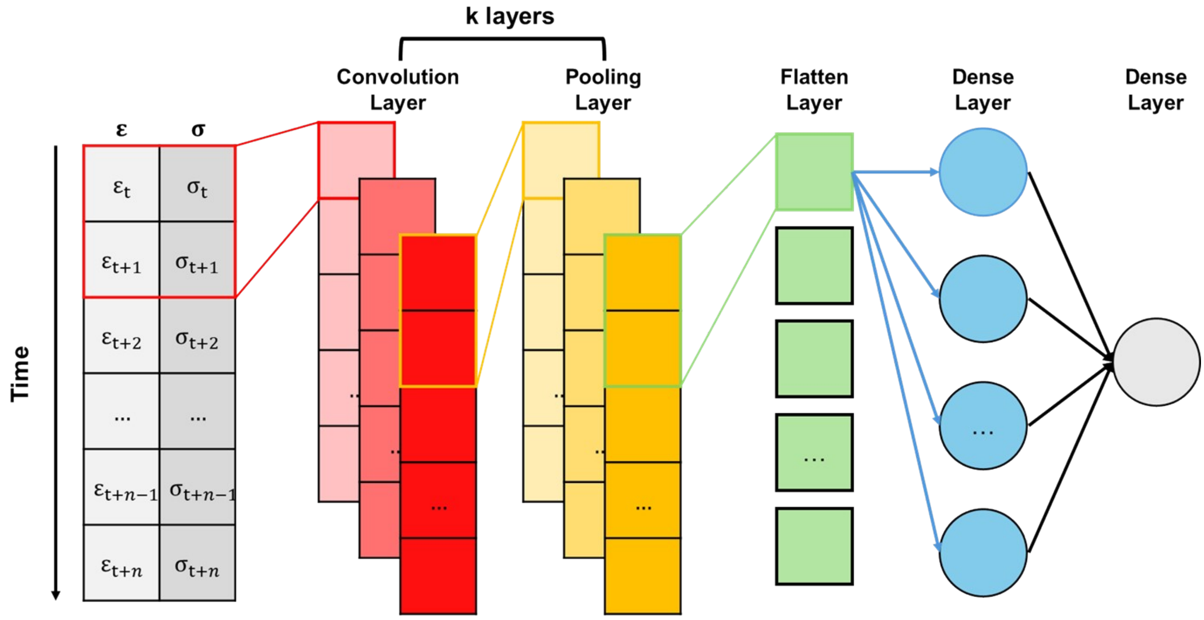

Figure S4. Architecture of the CNN-based fatigue life prediction model without an attention mechanism.

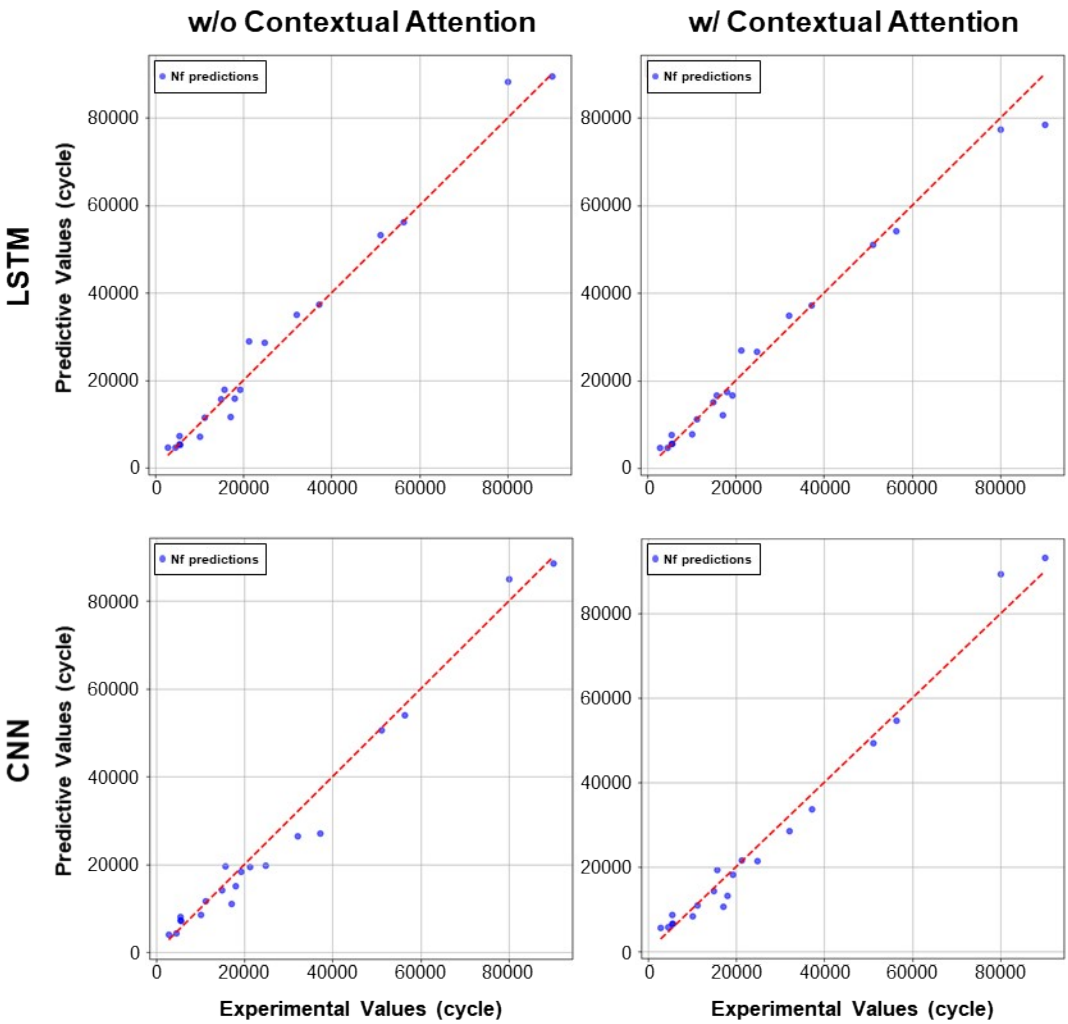

Figure S5. Scatter plots comparing predicted fatigue life to experimental fatigue life values for the LSTM, CNN, LSTM with attention, and CNN with attention models. The red dashed line represents perfectly matched predictions and experimental values.