

Handwritten musical notation on a staff, including notes, rests, and dynamic markings such as *f* and *ff*.

The image shows a complex musical score with multiple staves. The notation is dense, with many notes and rests. Dynamic markings such as 'f' (forte) and 'ff' (fortissimo) are scattered throughout. Several vertical blue lines are drawn across the staves, highlighting specific measures or sections of the music. The overall appearance is that of a technical or academic musical manuscript.

2. Preliminary considerations

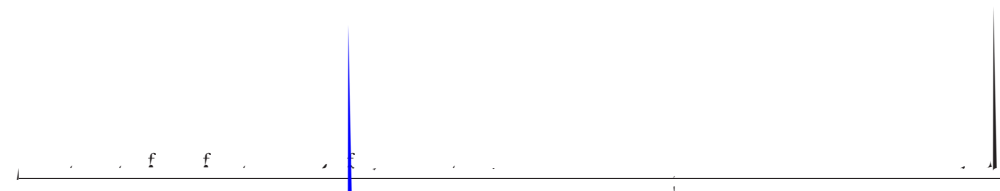
A single musical staff is visible at the bottom of the page, containing several notes and dynamic markings, including 'f' and 'ff'. It appears to be a continuation or a specific example related to the main score above.

$$D_c = \left\{ (p_1, p_2), \sqrt{p_1^2 + p_2^2} \leq c \right\},$$

$$f(\mathbf{x}) = f(p_1, p_2) = \frac{1}{(2\pi)^2} \int_{D_c} \hat{f}(p_1, p_2) e^{i(p_1 x_1 + p_2 x_2)} dp_1 dp_2$$

$$B = \left[-\frac{c}{2}, \frac{c}{2}\right] \times \left[-\frac{c}{2}, \frac{c}{2}\right] \quad W = c^2$$

$$f_B = \int_B f(\mathbf{x}) \delta(\mathbf{x}) d\mathbf{x}$$



Let $\mathbf{x} \in B$. Then

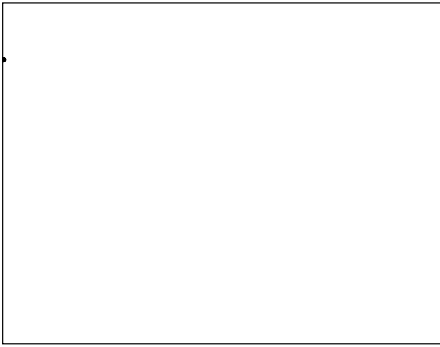
$$f(\mathbf{x}) = \int_B K_c(\mathbf{y} - \mathbf{z}) f(\mathbf{z}) d\mathbf{z}$$

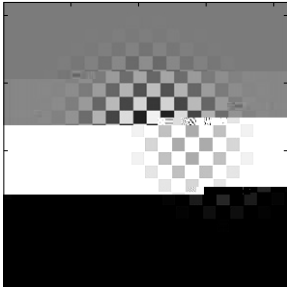
For $\mathbf{y}, \mathbf{z} \in B$, we have $\|\mathbf{y} - \mathbf{z}\| \leq \text{diam}(B) =: \delta$. Since K_c is a kernel function, we can write

$$K_c(\mathbf{y} - \mathbf{z}) = \int_B |\mathbf{y} - \mathbf{z}|^{-\alpha} d\mathbf{z}$$

where $\alpha > 0$ is a constant. This implies that the kernel function is bounded and continuous on the domain B .

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$$\mathbf{f}_\omega = \mathbf{g}_\omega \mathbf{f} \quad \mathbf{x}^\omega \quad \mathbf{f}$$

$$F_{\omega,c}, \mathbb{C}_\omega^{N_\omega} \quad L_{D,c}$$

$$\hat{f}_\omega(\mathbf{p}) = F_{\omega,c} \mathbf{f}_\omega(\mathbf{p}) = \sum_{\omega}^{N_\omega} \omega f(\mathbf{x}^\omega) e^{-c\mathbf{p} \cdot \mathbf{x}^\omega}$$

$$\mathbb{C}_\omega^{N_\omega} \quad L_{D,c} \quad \mathbf{f}$$

$$F_{\omega,c}, L_{D,c} \quad \mathbb{C}_\omega^{N_\omega} \quad F_{\omega,c} = \frac{c}{D} \int_D (\mathbf{p}) e^{-c\mathbf{p} \cdot \mathbf{x}^\omega} \mathbf{p}$$

$$\mathbf{x}^\omega \quad \omega^\omega \quad Q_{\omega,c} = F_{\omega,c} F_{\omega,c}^\dagger$$

$$Q_{\omega,c}, \mathbb{C}_\omega^{N_\omega} \quad \mathbb{C}_\omega^{N_\omega} \quad Q_{\omega,c} \mathbf{f}_\omega = \frac{c}{D} \int_D \hat{f}_\omega(\mathbf{p}) e^{-c\mathbf{p} \cdot \mathbf{x}^\omega} \mathbf{p}$$

$$(Q_{\omega,c}) = K_c \left(\frac{1}{\omega}, \frac{1}{\omega} \right) \omega$$

$$\omega = \sum_{\omega}^{N_\omega} \frac{1}{\omega} K_c \left(\frac{1}{\omega}, \frac{1}{\omega} \right) \frac{1}{\omega} \omega$$

$$\omega = \left\{ \frac{1}{\omega} \right\}_{\omega}^{N_\omega}$$

$$\omega = \left\{ \frac{1}{\omega} \right\}_{\omega}^{N_\omega}$$

$$Q_{\omega,c} \omega = \omega \omega$$

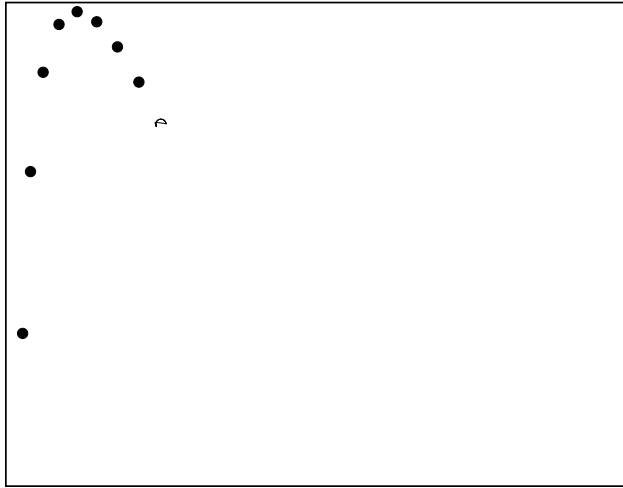
$$\left(\frac{1}{\omega}, \frac{1}{\omega} \right)_\omega =$$

$$K_c(\mathbf{x}) = \frac{1}{c} \int_{\Gamma} \int_{\Gamma} f(\mathbf{x}, \mathbf{y}) \omega(\mathbf{y}) d\mathbf{y} d\mathbf{x} \geq \omega^-$$

3. Discretization of the kernel

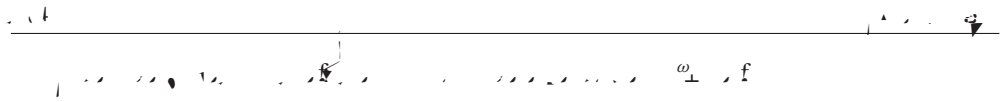
$$K_c(\mathbf{x}) = \frac{1}{c} \int_{\Gamma} \int_{\Gamma} f(\mathbf{x}, \mathbf{y}) \omega(\mathbf{y}) d\mathbf{y} d\mathbf{x} \approx \frac{1}{c} \sum_{i=1}^n p_i f(\mathbf{x}, \mathbf{y}_i) \omega(\mathbf{y}_i)$$

$$K_c(\mathbf{x}) = \frac{c}{T} \int_{\Gamma} \int_{\Gamma} f(\mathbf{x}, \mathbf{y}) \omega(\mathbf{y}) d\mathbf{y} d\mathbf{x} \quad T = \int_{\Gamma} \int_{\Gamma} \omega(\mathbf{y}) d\mathbf{y} d\mathbf{x}$$

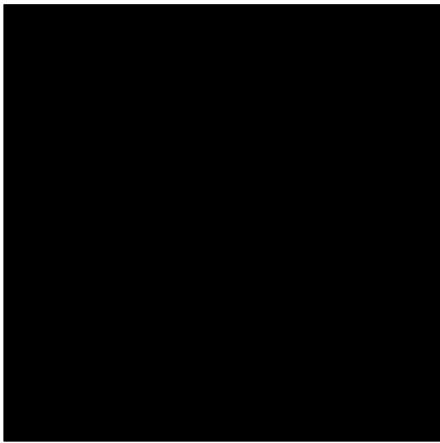


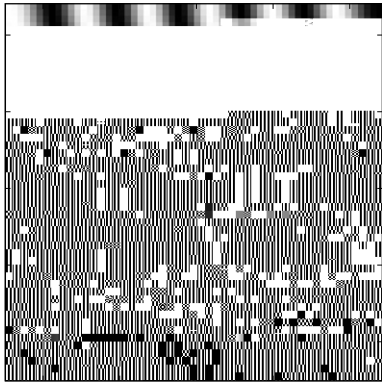
$f \in \mathbb{C}^N$
 $A = EW$

$$|EWf, f| = \left| \sum \sum e_{ij} f_j \bar{f}_i \right| \leq \left| \sum \omega_j f_j \right|,$$

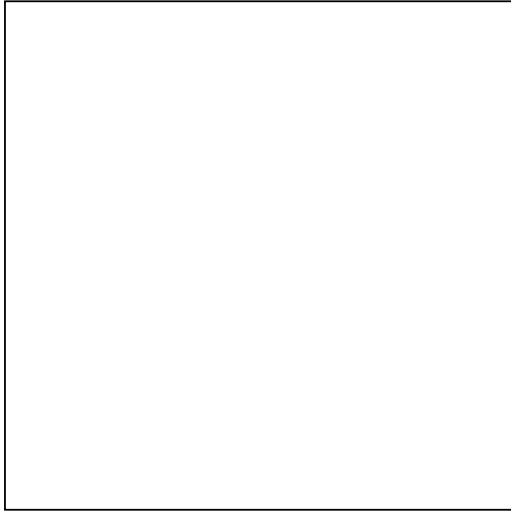


$$\mathbf{d} = \sum_{J \dots}$$

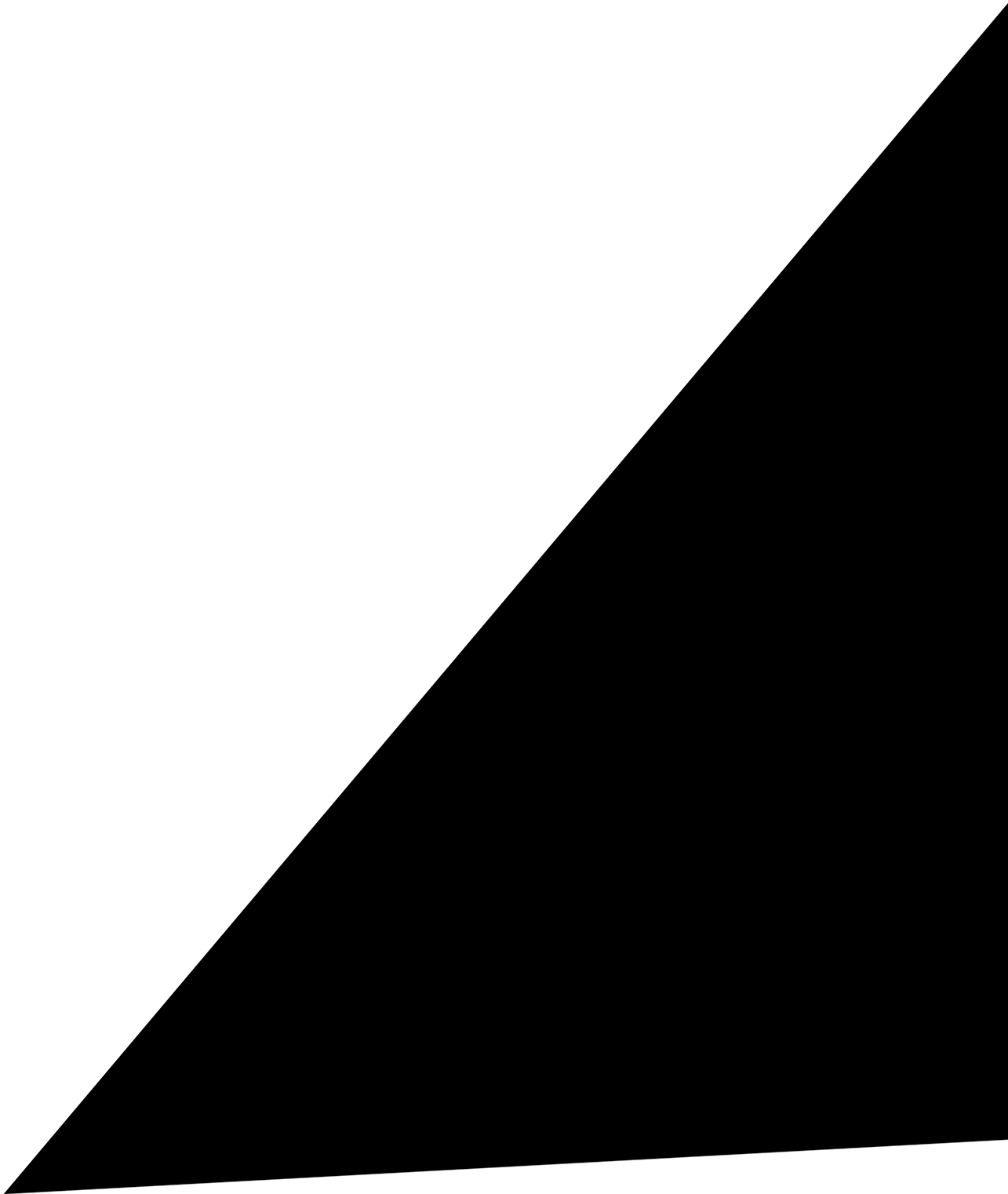
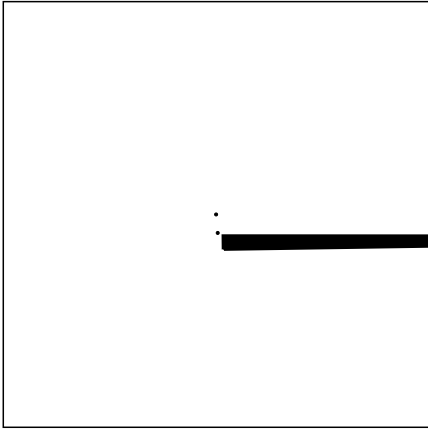




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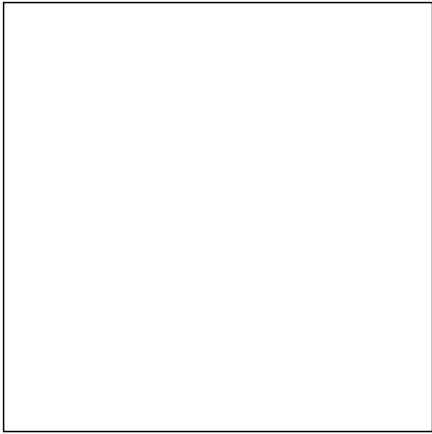
... f f ... f ...

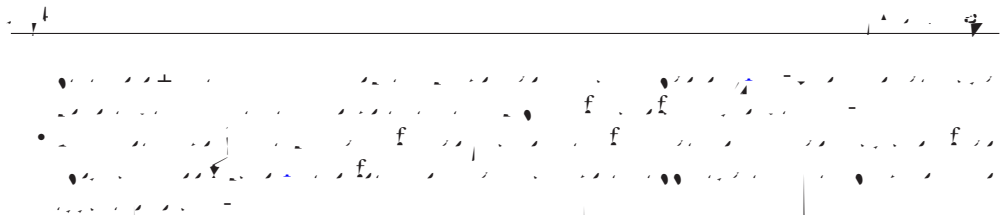


$$r = \left(\frac{L}{L} \right), \quad = 1, \dots, L-1,$$

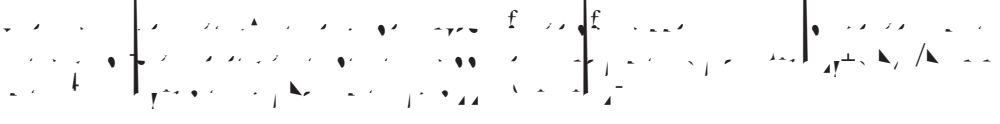
$$U_{L-1}(r) = \dots$$

..... f f f

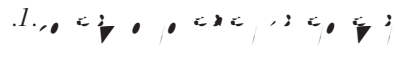


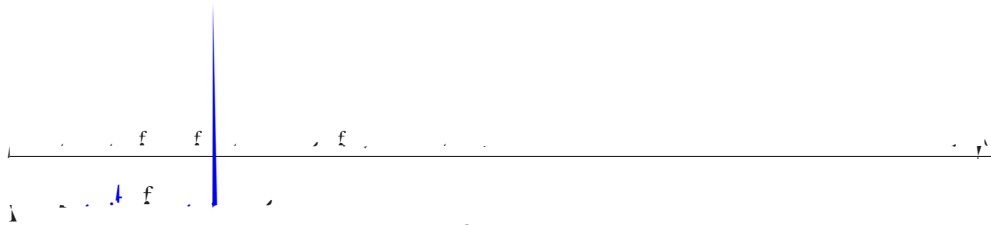


Acknowledgments



Appendix A





$$|\langle \mathbf{f}_{\omega} - \mathbf{d}, \omega \rangle| \leq \frac{C_{\omega} \mathbf{f}_{\omega}}{\omega},$$

