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Notational Conventions

Algebra As usual, $\mathbf{R}$ and $\mathbb{C}$ denote the fields of real and complex numbers, respectively, and $\mathbb{Z}$ the ring of integers. Let

$$\mathbf{R}^+ = \{t \in \mathbf{R} : t \geq 0\}, \quad \mathbb{Z}^+ = \mathbb{Z} \cap \mathbf{R}^+ .$$

If $\alpha \in \mathbb{C}$, $\operatorname{Re}\alpha$ denotes the real part of α, $\operatorname{Im}\alpha$ its imaginary part, $|\alpha|$ its modulus.

If G is a group, $A \subset G$ a subset and $g \in G$ an element, we put

$$A^g = \{gag^{-1} : a \in A\}, g^A = \{aga^{-1} : a \in A\}.$$

The group of real matrices leaving invariant the quadratic form

$$x_1^2 + \cdots + x_p^2 - x_{p+1}^2 - \cdots - x_{p+q}^2$$

is denoted by $\mathbf{O}(p,q)$. We put $\mathbf{O}(n) = \mathbf{O}(o,n) = \mathbf{O}(n,o)$, and write $\mathbf{U}(n)$ for the group of $n \times n$ unitary matrices. The group of isometries of Euclidean n-space $\mathbf{R}^n$ is denoted by $M(n)$.

Geometry The $(n-1)$-dimensional unit sphere in $\mathbf{R}^n$ is denoted by $\mathbf{S}^{n-1}$, Ω_n denotes its area. The n-dimensional manifold of hyperplanes in $\mathbf{R}^n$ is denoted by $\mathbf{P}^n$. If $0 < d < n$ the manifold of d-dimensional planes in $\mathbf{R}^n$ is denoted by $G(d,n)$; we put $G_{d,n} = \{\sigma \in G(d,n) : o \in \sigma\}$. In a metric space, $B_r(x)$ denotes the open ball with center x and radius r; $S_r(x)$ denotes the corresponding sphere. For $\mathbf{P}^n$ we use the notation $\beta_A(0)$ for the set of hyperplanes $\xi \subset \mathbf{R}^n$ of distance $< A$ from 0, σ_A for the set of hyperplanes of distance $= A$. The hyperbolic n-space is denoted by $\mathbf{H}^n$ and the n-sphere by $\mathbf{S}^n$.

Analysis If X is a topological space, $C(X)$ (resp. $C_c(X)$) denotes the sphere of complex-valued continuous functions (resp. of compact support). If X is a manifold, we denote:

$$\begin{aligned}
C^m(X) &= \left\{ \begin{array}{l} \text{complex-valued } m\text{-times continuously} \\ \text{differentiable functions on } X \end{array} \right\} \\
\mathcal{C}^\infty(X) &= \mathcal{E}(X) = \cap_{m>0} C^m(X) . \\
\mathcal{C}_c^\infty(X) &= \mathcal{D}(X) = C_c(X) \cap \mathcal{C}^\infty(X) . \\
\mathcal{D}'(X) &= \{\text{distributions on } X\} . \\
\mathcal{E}'(X) &= \{\text{distributions on } X \text{ of compact support}\} . \\
\mathcal{D}_A(X) &= \{f \in \mathcal{D}(X) : \text{ support } f \subset A\} . \\
\mathcal{S}(\mathbf{R}^n) &= \{\text{rapidly decreasing functions on } \mathbf{R}^n\} . \\
\mathcal{S}'(\mathbf{R}^n) &= \{\text{tempered distributions on } \mathbf{R}^n\} .
\end{aligned}$$

The subspaces $\mathcal{D}_H$, $\mathcal{S}_H$, $\mathcal{S}^*$, $\mathcal{S}_o$ of $\mathcal{S}$ are defined pages in Ch. I, §§1–2.

While the functions considered are usually assumed to be complex-valued, we occasionally use the notation above for spaces of real-valued functions.

The Radon transform and its dual are denoted by $f \to \widehat{f}$, $\varphi \to \check{\varphi}$, the Fourier transform by $f \to \widetilde{f}$ and the Hilbert transform by $\mathcal{H}$.

I^α, I_-^λ, I_o^λ and I_+^λ denote Riesz potentials and their generalizations. M^r the mean value operator and orbital integral, L the Laplacian on $\mathbf{R}^n$ and the Laplace-Beltrami operator on a pseudo-Riemannian manifold. The operators $\square$ and Λ operate on certain function spaces on $\mathbf{P}^n$; $\square$ is also used for the Laplace-Beltrami operator on a Lorentzian manifold, and Λ is also used for other differential operators.

Index

Errata and Addenda in S. Helgason: The Radon Transform 2$^{\text{nd}}$ Edition (First Printing)

These have been entered in the downloadable version.

Page and line in $\left\{\begin{array}{l}\text{above}\\ \text{below}\end{array}\right.$	Instead of:	Read:
3^2	omit "φ on $\mathbb{P}\ldots$, functions "	
5_{10}	R^n	$\mathbb{P}^n$
11_{12}	$\pi^{-\frac{1}{2}}$	$\pi^{\frac{1}{2}}$
12^4	(i)	(ii)
16_{11}	$dk)$	$)dk$
17_{14}	replaced by $f(x) = 0(\lvert x\rvert^{-n})$	dropped
17_{13}	with	for all lines with
25_{18}	$f * \varphi$	$f \times \varphi$
26_{14}	$\neq$	$=$
26^{12}	$\operatorname{supp}(\widehat{S}) \subset S_R(0)$	$\operatorname{supp}(S) \subset S_R(0)$
28^8	ψ_n	ψ
34^9	(63)	(64)
35^3	(68)	(69)
35^7	i, j	$i \neq j$
$35^6, 35_1, 36^2, 36^9$	$\partial_{2,1}, \partial_{2,d+1}$	$\partial_{1,1}, \partial_{1,d+1}$
$36^9, 36^{12}, 36^{14}$	$\partial_{2,n}$	$\partial_{1,n}$
39^7	$-\xi_1 + \xi_2 - \eta_1$	$-\xi_1 + \xi_2 + \eta_1$
40^7	z^2	$(z^2 + 1)$
40_3	xy	xy^2
42_5	$f_1(0)$	$f_1(x)$
42_2	$h(\langle x, w\rangle)$	$h(\langle x, w\rangle + t)$

Page and line in $\left\{\begin{array}{l}\text{above}\\ \text{below}\end{array}\right.$	Instead of:	Read:
44^9	w_{i_k}	$w_{i_k}\,dw$
44_5	$\widetilde{f}$	$\widetilde{f}_1$
58^{11}	o	c
62^4	$(\lambda(D)f)\check{}$	$(\lambda(D)f)\widehat{}$
67^4	cosh	coth
69^3	$k'a_{t'}, n'a_tN\cdot 0$	$k'a_{t'}n'a_tN\cdot 0$
69^{12}	-2	-1
69_6	$ch\,s$	$ch^3 s$
97^5	a circle	two circles.
97^7	"a circular arc"	"a pair of circular arcs"
98	$k-1$	$(k-1)!$.
101^{10}, 101_2	$f\times\tau$	$\pi^{-1}f\times\tau$
101_7	$-4\pi^2$	-4π
103^3, 103^{12}	$(4n+1)\sum_0^\infty$	$\sum_0^\infty(4n+1)$
119^6	formula	formula $f=Q(L)((\widehat{f})\check{}\,)$. Here Q is given by
153_4	sequences	positive sequences
153_{15}	$n+1$	$-(n+1)$
153^5	Absolute value signs missing	
156_2	(1)	(25)
156_5	Interchange P_1 and G_1	
167^{13}	(60)	(61)
180^{12}	397	394

44_4 Here one should use the following remark: If $\varphi(\lambda)$ is even, holomorphic on $\mathbb{C}$ and satisfies the exponential type estimate (13) in Theorem 3.3, Ch. V, then the same holds for the function Φ on $\mathbb{C}^n$ given by $\Phi(\zeta) =$

$\Phi(\zeta_1,\ldots,\zeta_n)=\varphi(\lambda)$ where $\lambda^2=\zeta_1^2+\cdots+\zeta_n^2$. To see this put

$$\lambda=\mu+iv\,,\quad \zeta=\xi+i\eta \qquad \mu,\nu\in\mathbf{R}\,,\quad \xi\,,\,\eta\in\mathbf{R}^n\,.$$

Then

$$\mu^2-\nu^2=|\xi|^2-|\eta|^2\,,\quad \mu^2\nu^2=(\xi\cdot\eta)^2\,,$$

so

$$|\lambda|^4=(|\xi|^2\,-\,|\eta|^2)^2+4(\xi\cdot\eta)^2$$

and

$$2|\operatorname{Im}\,\lambda|^2=|\eta|^2-|\xi|^2+\left[(|\xi|^2-|\eta|^2)^2+4(\xi\cdot\eta)^2\right]^{1/2}\,.$$

Since $|(\xi\cdot\eta)|\leq|\xi|\,|\eta|$ this implies $|\operatorname{Im}\,\lambda|\leq|\eta|$ so the estimate (13) follows for Φ.

45_1 Note that Part (ii) can also be stated: The solution is outgoing (incoming) if and only if

$$\int_\pi f_0=\int_{H_\pi}f_1 \qquad \Big(\int_\pi f_0=-\int_{H_\pi}f_1\Big)$$

for an arbitrary hyperplane $\pi (0\notin\pi)$ H_π being the halfspace with boundary π which does not contain 0.

58^{11} The subscripts 0 should be c.

102^4 The function τ is only locally integrable but not integrable. However for λ real $\tau\varphi_\lambda$ is integrable and (62) holds by virtue of the proof of (53), p. 100.

102_{11} The implication (62) & (63) $\Rightarrow$ (60) is justified as follows. Using the decomposition $\tau=\varphi\tau+(1-\varphi)\tau$ where φ is the characteristic function of a ball $B(0)$ we see that $f\times\tau\in L^2(X)$ for $f\in\mathcal{D}^\natural(X)$. Since $\sigma\in L^1(X)$ we have $f\times\tau\times\sigma\in L^2(X)$. Now (60) follows since by the Plancherel theorem the spherical transform is injective on L^2.

155^3 From formula (24) below for $j=0$ and $j=1$, it is clear that sequences $\delta_1,\delta_2,\ldots,M_1,M_2,\ldots(\delta_i>0,M_1>0)$ exist such that (3) holds for $j=0$, $j=1$. Fix the δ_1 and M_1. Then the idea is to shrink $\delta_2,\delta_3\ldots$ and $1/M_2,1/M_3,\ldots$ so that by the argument below, (3) holds for $j=2$, etc.

167^{13} (60) should be (61). It should also be observed as a result of (39) that if $f(x)=O(|x|^{-N})$ then $I^\lambda f)(x)$ is holomorphic near $\lambda=0$ and $I^0=f$.

168_{11} The idea of a proof of this nature involving a contour like Γ_m appears already in Ehrenpreis [1956], although not correctly carried out in details.