Want $\boxed{\mathbb{E}\, g^{T}(t)\, g^{T}(s)}$ $\quad g: \mathbb{R}^n \to \mathbb{R}^n$

$$g(s) = g(t) + \nabla g\,(t-s) + \nabla^2 g\,(t-s, t-s)$$

$: \mathbb{R}^n \to \mathbb{R}^{m}$

$$\mathbb{E}[g^T(t) g(t)] = I \quad : \quad \mathbb{R}^n \to \mathbb{R}^n$$

$$\Rightarrow \quad \nabla \mathbb{E}[g^T(t) g(t)]$$

$$\mathrm{vech}(\mathbb{E}[g^T(t) g(t)]) = \mathrm{vech}(I)$$

$$\cancel{\mathbb{E}[g^T(t) \nabla g(t)]}$$

so $\cancel{\mathbb{E}\, g_t}$ $\quad \mathbb{E}[g_i(t) g_j(t)] = \delta_{ij}$

$$\cancel{\mathbb{E}[g_i(t) g_j(t)] = a}$$

$$\mathbb{E}\left[\frac{\partial g_i}{\partial t_n}(t) g_j(t) + g_i(t)\frac{\partial g_j}{\partial t_n}(t)\right] = 0$$

$\cancel{\mathrm{cov}}$ $\quad \mathbb{E}[g_i(t) g_j(t)] = \delta_{ij} = 0$ if $i \neq j$

$$\mathbb{E}\left[g_i(t) \frac{\partial}{\partial t_n} g_j(t)\right]$$

$$\mathbb{E}\left[g_i(t) \lim_{h \to 0} \frac{g_j(t+h) - g_j(t)}{h}\right]$$

$$= \lim_{h \to 0} \mathbb{E}\left[\frac{g_j(t+h) g_i(t) - g_i(t) g_j(t)}{h}\right]$$