Observe that we did not compute the partial derivative with respect to w because it does not yield any useful information due to the presence of the term $\|w\|_2$ (as opposed to $\|w\|_2^2$). Our minimization problem is reduced to: find

$$
\begin{aligned}
&\inf_{w, \|w\| \leq 1} \left(w^\top \left(\sum_{j=1}^q \mu_j v_j - \sum_{i=1}^p \lambda_i u_i \right) + \gamma \|w\|_2 - \gamma \right) \\
&= -\gamma - \gamma \inf_{w, \|w\| \leq 1} \left(-w^\top \frac{1}{\gamma} \left(\sum_{j=1}^q \mu_j v_j - \sum_{i=1}^p \lambda_i u_i \right) + \|-w\|_2 \right) \\
&= \begin{cases} -\gamma & \text{if } \left\| \frac{1}{\gamma} \left(\sum_{j=1}^q \mu_j v_j - \sum_{i=1}^p \lambda_i u_i \right) \right\|_2^D \leq 1 \\ -\infty & \text{otherwise} \end{cases} && \text{by Example 50.8(6)} \\
&= \begin{cases} -\gamma & \text{if } \left\| \sum_{j=1}^q \mu_j v_j - \sum_{i=1}^p \lambda_i u_i \right\|_2 \leq \gamma \\ -\infty & \text{otherwise.} \end{cases} && \text{since } \|\ \|_2^D = \|\ \|_2 \text{ and } \gamma > 0
\end{aligned}
$$

It is immediately verified that the above formula is still correct if $\gamma = 0$. Therefore

$$
G(\lambda, \mu, \gamma) = \begin{cases} -\gamma & \text{if } \left\| \sum_{j=1}^q \mu_j v_j - \sum_{i=1}^p \lambda_i u_i \right\|_2 \leq \gamma \\ -\infty & \text{otherwise.} \end{cases}
$$

Since $\left\| \sum_{j=1}^q \mu_j v_j - \sum_{i=1}^p \lambda_i u_i \right\|_2 \leq \gamma$ iff $-\gamma \leq -\left\| \sum_{j=1}^q \mu_j v_j - \sum_{i=1}^p \lambda_i u_i \right\|_2$, the dual program, maximizing $G(\lambda, \mu, \gamma)$, is equivalent to

$$
\begin{aligned}
&\text{maximize} \quad -\left\| \sum_{j=1}^q \mu_j v_j - \sum_{i=1}^p \lambda_i u_i \right\|_2 \\
&\text{subject to} \\
&\qquad \sum_{i=1}^p \lambda_i = 1, \ \ \lambda \geq 0 \\
&\qquad \sum_{j=1}^q \mu_j = 1, \ \ \mu \geq 0,
\end{aligned}
$$