**Making Cancer Treatments Safer with Mathematics**

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**THE PROBLEM**

**Brachytherapy:** a radiation treatment where radioactive seeds are placed directly on the tumour.

**Issue:** when the tumour is located close to organs, the radiation can damage them, causing further health complications.

Where to place the radiation to minimise the damage to healthy tissue while still treating the tumour?

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**THE IMPACT**

Currently, clinicians do not have a tool to create treatment plans for brachytherapy.

This would provide them with one.

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**METHODS**

**Key Tool:**

PDE Constrained Optimisation

**Optimisation Problem**

A required dose for the tumour + A target dose for everywhere else + Physical Laws of Radiation Emission

**Method:** minimize a function that will enforce required constraints

- Find the $f$ that minimizes
  \[
  J(u, f) = \frac{1}{2} \| u - d_T \|_{L^2(\Omega)}^2 + \frac{\alpha}{2} \| f \|_{L^2(\Omega)}^2
  \]
- While making sure this is true
  \[
  \frac{\partial u}{\partial t} + \mu_a u - \nabla \cdot \left( \frac{1}{3\mu_a} \nabla u \right) = f
  \]

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**SIMULATIONS**

Output the source for the needed dose:

- Peak location = Seed location
- Peak height = Seed strength

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