# SciFetch Report

Generated on: 2025-06-28 22:53 UTC

**Request:** Sustainable materials in construction: Recent innovations in self-healing concrete

## Summary

Recent innovations in self-healing concrete have focused on enhancing the durability and sustainability of construction materials by incorporating biological and chemical agents that can autonomously repair cracks. Here are some of the most relevant papers and their contributions to this field: 1. **Bacterial Viability in Self-Healing Concrete: A Case Study of Non-Ureolytic Bacillus Species** - This study explores the use of bacteria encapsulated in cementitious materials to heal cracks in concrete. It highlights the importance of preserving bacterial viability within the cement matrix to ensure effective self-healing. The research focuses on non-ureolytic Bacillus species, which are encapsulated to promote crack healing through biological processes. 2. **Synthesis and Evaluation of Properties of an Additive Based on Bismuth Titanates for Cement Systems** - This paper discusses the development of innovative cement additives based on the TiO2-Bi2O3 system. These additives not only enhance the self-healing ability of concrete but also provide photocatalytic properties, contributing to energy efficiency and environmental friendliness. The study emphasizes the role of nano- and fine-dispersed additives in imparting new properties to cement systems. 3. **Study on the Performance of Recycled Coarse and Fine Aggregates as Microbial Carriers Applied to Self-Healing Concrete** - This research investigates the use of recycled

aggregates as carriers for microbial self-healing concrete (SHC). It addresses the scarcity of natural resources by utilizing recycled coarse and fine aggregates, which influence the repair performance of SHC. The study provides insights into the effectiveness of these recycled materials over time in promoting self-healing. 4. **Bioconcrete-Enabled Resilient Construction: a Review** - This review paper highlights the application of microbially induced calcium carbonate precipitation (MICCP) in self-healing concrete. It underscores the eco-friendly, economical, and simplistic nature of this approach, which supersedes conventional crack-repair methods. The paper discusses how bacteria within the concrete activate upon contact with water, leading to crack repair through natural carbonate precipitation. 5. **Multiple Self-Healing Effects of Water-Absorbing Microcapsules in Cementitious Materials** - This study introduces water-absorbing microcapsules containing healing agents pre-implanted into concrete. These microcapsules are designed to induce self-healing upon crack formation. The research addresses the challenges posed by environmental conditions on the self-healing effect and presents a novel approach using calcium alginate hydrogel and adhesive epoxy polymer as wall materials for the microcapsules. These papers collectively demonstrate the advancements in self-healing concrete technologies, focusing on biological and chemical methods to enhance the longevity and sustainability of construction materials.

## Relevant Articles

### 1. Quintessence and phantoms in light of DESI 2025

**Date:** 2025-06-26

**Source:** arXiv

**URL:** http://arxiv.org/abs/2506.21542v1

**Abstract:** We analyse DESI BAO, CMB, and supernova data to explore the physical origin of the DESI indication for dynamical dark energy. Beyond the standard CPL parametrization, we explore truncated alternatives and quintessence models. We conclude that there is compelling evidence for dark energy to be decaying in the late universe, but the evidence for a phantom behaviour is less significant. Models without phantom behaviour are compatible with the data at the $2\sigma$ CL. Furthermore, we examine a conc...

## 2. PsyLite Technical Report

**Date:** 2025-06-26

**Source:** arXiv

**URL:** http://arxiv.org/abs/2506.21536v1

**Abstract:** With the rapid development of digital technology, AI-driven psychological counseling has gradually become an important research direction in the field of mental health. However, existing models still have deficiencies in dialogue safety, detailed scenario handling, and lightweight deployment. To address these issues, this study proposes PsyLite, a lightweight psychological counseling large language model agent developed based on the base model InternLM2.5-7B-chat. Through a two-stage training st...

## 3. The spectrum of global representations for families of bounded rank and VI-modules

**Date:** 2025-06-26

**Source:** arXiv

**URL:** http://arxiv.org/abs/2506.21525v1

**Abstract:** A global representation is a compatible collection of representations of the outer automorphism groups of the finite groups belonging to a family $\mathscr{U}$. These arise in classical representation theory, in the study of representation stability, as well as in global homotopy theory. In this paper we begin a systematic study of the derived category $\mathsf{D}(\mathscr{U};k)$ of global representations over fields $k$ of characteristic zero, from the point-of-view of tensor-triangular geometr...

## 4. Efficient and Reuseable Cloud Configuration Search Using Discovery Spaces

**Date:** 2025-06-26

**Source:** arXiv

**URL:** http://arxiv.org/abs/2506.21467v1

**Abstract:** Finding the optimal set of cloud resources to deploy a given workload at minimal cost while meeting a defined service level agreement is an active area of research. Combining tens of parameters applicable across a large selection of compute, storage, and services offered by cloud providers with similar numbers of application-specific parameters leads to configuration spaces with millions of

deployment options. In this paper, we propose Discovery Space, an abstraction that formalizes the descri...

## 5. Plasmonically Enhanced Flexural-Mode AlScN Nanoplate Resonator as Uncooled and Ultrafast IR Detector with High Responsivity

**Date:** 2025-06-26

**Source:** arXiv

**URL:** http://arxiv.org/abs/2506.21412v1

**Abstract:** This letter introduces a novel class of miniaturized, uncooled, and ultra-fast infrared (IR) resonant thermal detectors (RTDs) based on 30%-doped Aluminum Scandium Nitride (AlScN) nanoplates. Exploiting high electromechanical coupling, good thermal properties, and enhanced and selective IR absorption, the presented device aims to demonstrate significant advancements over the state-of-the-art IR RTDs. This single pixel combines compact footprint, high spectral selectivity and responsivity, reduce...

## 6. Distributed Cross-Channel Hierarchical Aggregation for Foundation Models

**Date:** 2025-06-26

**Source:** arXiv

**URL:** http://arxiv.org/abs/2506.21411v1

**Abstract:** Vision-based scientific foundation models hold significant promise for advancing scientific discovery and innovation. This potential stems from their ability to aggregate images from diverse sources such as varying physical groundings or data acquisition systems and to learn spatio-temporal correlations using transformer architectures. However, tokenizing and aggregating images can be compute-intensive, a challenge not fully addressed by current distributed methods. In this work, we introduce th...

## 7. Ghost-Free Quantisation of Higher Time-Derivative Theories via Non-Unitary Similarity Transformations

**Date:** 2025-06-26

**Source:** arXiv

**URL:** http://arxiv.org/abs/2506.21400v1

**Abstract:** We address the long-standing ``ghost problem" in higher time-derivative theories (HTDTs), where quantisation typically yields sectors with either unbounded spectra or non-normalisable eigenstates; both rendering the theory unphysical. We propose a novel method that preserves the bounded nature of the spectrum in one particular sector while restoring normalisability by employing a non-unitary similarity transformation. Inspired by techniques from pseudo/quasi-Hermitian PT-symmetric quantum mechan...

## 8. TableMoE: Neuro-Symbolic Routing for Structured Expert Reasoning in Multimodal Table Understanding

**Date:** 2025-06-26

**Source:** arXiv

**URL:** http://arxiv.org/abs/2506.21393v1

**Abstract:** Multimodal understanding of tables in real-world contexts is challenging due to the complexity of structure, symbolic density, and visual degradation (blur, skew, watermarking, incomplete structures or fonts, multi-span or hierarchically nested layouts). Existing multimodal large language models (MLLMs) struggle with such WildStruct conditions, resulting in limited performance and poor generalization. To address these challenges, we propose TableMoE, a neuro-symbolic Mixture-of-Connector-Experts...

## 9. Visualization and manipulation of four-leaf clover-shaped electronic state in cuprate

**Date:** 2025-06-26

**Source:** arXiv

**URL:** http://arxiv.org/abs/2506.21392v1

**Abstract:** High-Tc superconductivity in cuprates arises from carrier doping of an antiferromagnetic Mott insulator. Associated with these changes are spectral-weight transfers from the high-energy to low-energy, giving rise to a variety

of intriguing electronic phenomena. In this study, for the first time, we discovered a 2a0 sized four-leaf clover-shaped (FLC) electronic state at low-energy, accompanied with the emergence of a characteristic "kink" around 16meV. With increasing doping, the number of FLC p...

## 10. Real-time Terrain Analysis for Off-road Autonomous Vehicles

**Date:** 2025-06-26

**Source:** arXiv

**DOI:** 10.4271/2025-01-8343

**URL:** http://arxiv.org/abs/2506.21347v1

**Abstract:** This research addresses critical autonomous vehicle control challenges arising from road roughness variation, which induces course deviations and potential loss of road contact during steering operations. We present a novel real-time road roughness estimation system employing Bayesian calibration methodology that processes axle accelerations to predict terrain roughness with quantifiable confidence measures. The technical framework integrates a Gaussian process surrogate model with a simulated h...

## 11. Bacterial Viability in Self-Healing Concrete: A Case Study of Non-UreolyticBacillusSpecies.

**Date:** 2023-09-26

**Source:** PubMed

**DOI:** 10.3390/microorganisms11102402

**URL:** https://pubmed.ncbi.nlm.nih.gov/37894059

**Abstract:** Cracking is an inevitable feature of concrete, typically leading to corrosion of the embedded steel reinforcement and massive deterioration because of the freezing-thawing cycles. Different means have been proposed to increase the serviceability performance of cracked concrete structures. This case study deals with bacteria encapsulated in cementitious materials to "heal" cracks. Such a biological self-healing system requires preserving the bacteria's viability in the cement matrix. Many embedde...

## 12. Synthesis and Evaluation of Properties of an Additive Based on Bismuth Titanates for Cement Systems.

**Date:** 2023-09-18

**Source:** PubMed

**DOI:** 10.3390/ma16186262

**URL:** https://pubmed.ncbi.nlm.nih.gov/37763540

**Abstract:** The development of modern building materials science involves the process of designing innovative materials that exhibit unique characteristics, such as energy efficiency, environmental friendliness, self-healing ability, and photocatalytic properties. This can be achieved by modifying cement with nano- and fine-dispersed additives that can give the material new properties. Such additives include a number of compounds based on the TiO2-Bi2O3system. These compounds have photocatalytic activity in...

## 13. Study on the Performance of Recycled Coarse and Fine Aggregates as Microbial Carriers Applied to Self-Healing Concrete.

**Date:** 2023-03-16

**Source:** PubMed

**DOI:** 10.3390/ma16062371

**URL:** https://pubmed.ncbi.nlm.nih.gov/36984251

**Abstract:** The contradiction between the scarcity of natural resources and the demand for construction materials has given rise to the application of recycled aggregates. Microbial self-healing concrete (SHC) is a clean and smart material, and its carrier has a great influence on repair performance. In this paper, recycled coarse aggregate (RCA) and recycled fine aggregate (RFA) were used as carriers, and their different repair effects over time were intensively investigated. The results showed that the RC...

## 14. Bioconcrete-Enabled Resilient Construction: a Review.

**Date:** 2023-03-28

**Source:** PubMed

**DOI:** 10.1007/s12010-023-04427-8

**URL:** https://pubmed.ncbi.nlm.nih.gov/36976510

**Abstract:** Concrete, the ubiquitous cementitious composite though immensely versatile, is crack-susceptible. Cracks let in deleterious substances causing durability issues. Superseding conventional crack-repair methods, the innovative application of microbially induced calcium carbonate precipitation (MICCP) stands prominent, being based on the natural phenomenon of carbonate precipitation. It is eco-friendly, self-activated, economical, and simplistic. Bacteria inside concrete get activated by contacting ...

## 15. Multiple Self-Healing Effects of Water-Absorbing Microcapsules in Cementitious Materials.

**Date:** 2023-01-13

**Source:** PubMed

**DOI:** 10.3390/polym15020428

**URL:** https://pubmed.ncbi.nlm.nih.gov/36679307

**Abstract:** Concrete cracking has a negative impact on the durability of the structure. Pre-implanting microcapsules

containing healing agents into the concrete are expected to induce the cracks to self-heal. However, the self-healing effect can potentially be influenced by several environmental conditions, thus limiting its applications. To address these challenges, we developed a new type of water-absorbing microcapsules, using calcium alginate hydrogel as the wall material and an adhesive epoxy polymer a...

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**Developed by:** Íñigo Rodríguez, AI & Data Engineer

**GitHub:** @irdsn